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Geological Setting of Mineralization in the Mine Centre–Fort Frances Area

**Ontario Geological Survey
Mineral Deposits Circular 29**

K.H. Poulsen

2000

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MAP

Map 2525 - Precambrian Geology and Mineral Occurrences, Mine Centre-Fort Frances area,
scale 1:50 000 back pocket

Foreword

This report was written when the author was employed by the Ontario Geological Survey to do a metallogenic investigation of the Mine Centre–Fort Frances area. The report and map were submitted in the 1980s, but editing and production were delayed by priorities related to the Geology of Ontario Special Volume project. The report is still the most comprehensive investigation of this area and we are thus proud to have it appear in final form.

Geological Setting of Mineralization in the Mine Centre–Fort Frances Area

K. H. Poulsen

Manuscript approved for publication by B.O. Dressler, Supervising Geologist, Precambrian Geology Section, Ontario Geological Survey, June 30, 1989. Report published with the permission of the Senior Manager, Precambrian Geoscience Section, Ontario Geological Survey.

Abstract

The rocks of the Mine Centre–Fort Frances area occur within the Archean Superior Province in a fault-bounded wedge between 2 subprovinces, the Wabigoon granite-greenstone terrane to the north and the Quetico metasedimentary terrane to the south. The Quetico and Rainy Lake–Seine River faults define this dextral wrench zone which displays distinctive stratigraphic, structural and metamorphic relationships.

Representatives of all major rock types of Archean terrane (mafic to felsic metavolcanic rocks, wackes and mudstones, conglomerates and arenites, layered gabbroic intrusions, tonalitic intrusions and granodiorite–quartz monzonite plutons) are juxtaposed here. In addition to the lithologic diversity, a wide variety of mineral deposit types is present.

Stratiform volcanic-hosted mineralization consists of ironstones, base metal sulphides and intercalations of the two. Four subtypes are recognized. First, narrow lenses of zinc-lead sulphide mineralization (Gagne Lake type) are overlain by chert and underlain by sulphide-bearing, altered lapilli tuff which locally consists of a chlorite + cordierite + anthophyllite assemblage. Second, wide zones of low-grade zinc-copper sulphide mineralization (Port Arthur Copper type) consist of 1 to 20 cm wide seams of massive sphalerite-chalcopryrite-pyrite which are intercalated with similar widths of barren chlorite schist. The host rock is commonly a brecciated amygdaloidal mafic metavolcanic, but felsic metavolcanic rocks occur both above and below the mineralized horizon. Third, zinc-copper mineralization (Pocket Pond type) is found in black pyritic shale and in massive pyrite-pyrrhotite lenses which are conformable to chert-magnetite ironstones; grades of 1 to 2% zinc occur over 5 m widths. Fourth, ironstones composed of chert-magnetite, massive sulphide mineralization and minor skarn commonly contain only traces of chalcopryrite.

Layered gabbro-anorthosite sills contain both sulphide and oxide mineralization. Chalcopryrite-pyrrhotite lenses containing minor cubanite, pentlandite, molybdenite, apatite and ilmenite are distributed along the base of the Grassy Portage intrusion, the best concentrations composing the North Rock deposit of 300 000 t grading 1.89% copper. This type of mineralization displays magmatic net and droplet textures as well as local zones of remobilized sulphide minerals and hydrothermal alteration. At a higher stratigraphic level in the intrusion, lower grade copper mineralization is found within a siliceous host which may represent assimilated country rock. Iron-titanium oxide mineralization also occurs as massive magnetite-ilmenite and as irregular masses of nelsonite, a rutile-bearing rock. Oxide mineralization is also well developed in the Seine Bay anorthositic sill.

Quartz vein mineralization is of 2 types. Molybdenite, along with pyrite and local chalcopryrite, occurs in quartz stockworks and extensional veins within granodioritic intrusions near contacts with the metasedimentary country rocks. In contrast, gold, along with carbonates and base metal sulphide minerals, occurs in lenticular quartz veins associated with shear zones and regional cleavage. Gold-bearing quartz veins occur in a variety of rock types and are restricted to zones of greenschist facies metamorphism.

A distinctive clastic ultramafic unit is exposed within the mafic portion of the volcanic succession. It is likely of epiclastic origin and is compositionally magnesian (21% MgO). Local zones of foliated ultramafic rock contain disseminated nickel-copper sulphide mineralization which may have resulted from metamorphic remobilization.

The best exploration opportunities in the area lie in the search for larger gold-bearing shear zone systems, base metal mineralization associated with the altered portions of the felsic sequence between Sandpoint Island and Mine Centre, and chalcopryrite at the base of the Grassy Portage intrusion.

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Introduction

The Archean rocks of the Wabigoon Subprovince of northwestern Ontario host several producing and past-producing deposits of iron, base metals and gold. Most production has come from deposits near the subprovince margins. This publication describes the nature and distribution of mineralization along the southwestern margin of the subprovince at Rainy Lake, where an abnormal concentration of various types of mineralization is present.

REGIONAL SETTING

The rocks of the Mine Centre–Fort Frances area lie within a boundary zone between the Wabigoon and Quetico subprovinces of the Superior Structural Province. In the Atikokan–Fort Frances area of Ontario and adjacent parts of Minnesota, this boundary is defined by a system of steeply dipping dextral faults, the largest of which are the Quetico and Rainy Lake–Seine River faults (Figure 1). These major wrench faults bound a “wedge” of crust that is structurally discordant from both subprovinces, but because of a gross lithologic similarity, is generally considered to be part of the Wabigoon Subprovince.

Wabigoon Subprovince

The structure of the Wabigoon granite-greenstone terrane is dominated by domal features of variable size. The largest of these, such as the Rainy Lake complex and the Irene–Eltrut Lakes complex (see Figure 1), are greater than 50 km in diameter and are composed of smaller gneissic domes, central batholiths and marginal crescentic granitoid intrusions. The larger complexes and smaller gneissic domes have been interpreted as first- and second-order gneiss diapirs, respectively, which are the product of gravitational, solid state remobilization of tabular batholiths beneath the supracrustal sequence (Schwerdtner et al. 1979).

Supracrustal metavolcanic and metasedimentary rocks now occupy the margins of the gneissic domes, with the largest stratigraphic thicknesses preserved between the first-order structures. Metavolcanic rock types dominate and consist of metabasalt flows with local accumulations of flows, pyroclastic rocks and epiclastic rocks of intermediate to felsic composition. Metasedimentary rocks such as conglomerate, wacke, mudstone and iron formation form units within the volcanic sequences. A dolomite unit with algal stromatolite mounds occurs within the Steep Rock Group at Steep Rock Lake (see Figure 1). Numerous stocks, commonly of quartz monzonite, intrude both metavolcanic and metasedimentary supracrustal rocks (see Figure 1).

Wabigoon Subprovince supracrustal rocks are metamorphosed to assemblages characteristic of the greenschist and amphibolite facies (Ayres 1978). Highest metamorphic grades occur adjacent to the first-order structures.

With the exception of a few northwesterly striking Proterozoic diabase dikes, most of the Wabigoon Subprovince rocks in the Atikokan–Fort Frances area are of Archean age (Table 1). Although there is a discrepancy among ages derived by different geochronological methods, it is clear that the rocks of the area were thermally active in the interval of about 2700 to 2400 Ma. The oldest ages reflect widespread igneous activity, whereas successively younger ages are likely the result of metamorphism, metasomatism and crustal uplift.

Quetico Subprovince

The structure of the Quetico Subprovince contrasts with that of the Wabigoon Subprovince. It is characterized by a consistent strike of metasedimentary units subparallel to the Rainy Lake–Seine River fault. Near the northern boundary, low-grade metasedimentary rocks of the Quetico Subprovince dip steeply and display 3 discrete cleavage sets. An early set is subparallel to east-trending bedding but has a more northerly strike, whereas a second set with an even more northeasterly strike makes a moderate angle with bedding. A late set includes crenulation cleavage and kink bands which strike northwesterly and deflect the earlier cleavages as well as bedding. The metasedimentary strata commonly display well-developed graded bedding, and younging directions that, despite some reversals, are dominantly northward (Hawley 1930b; Merritt 1934; Ojakangas 1972; Harris 1974; Wood et al. 1980a, 1980b; this study). Southward, the metasedimentary rocks become migmatitic, and primary structures and cleavage are obscured: schist-rich and granite-rich migmatites possess bedding-parallel foliations which are folded into large, open, shallow-plunging structures that trend east (Southwick 1972; Southwick and Sims 1980). Major antiforms are commonly cored by massive granitoid bodies of irregular shapes (see Figure 1). These granites occur within a migmatitic terrane, the Vermilion granitic complex, which occupies the central part of the Quetico Subprovince.

The metasedimentary biotite schists are metamorphosed to assemblages indicative of a southward increase in metamorphic grade (Pirie and Mackasey 1978). Pelitic rocks with greenschist facies assemblages (chlorite + sericite; chlorite + biotite) are found just to the south of the subprovince boundary, whereas amphibolite facies assemblages (biotite + cordierite + staurolite + garnet + sillimanite; biotite + garnet + andalusite + staurolite; biotite + garnet + sillimanite) have been observed in the central part of the subprovince (Southwick 1976; Pirie and Mackasey 1978). The observed sequence of assemblages is consistent with moderate metamorphic pressures of 2 to 4 kilobars and temperatures ranging as high as 600°C. Geochronological data from this part of the Quetico Subprovince (see Table 1) show that most igneous and metamorphic events were broadly contemporaneous with those in the Wabigoon Subprovince.

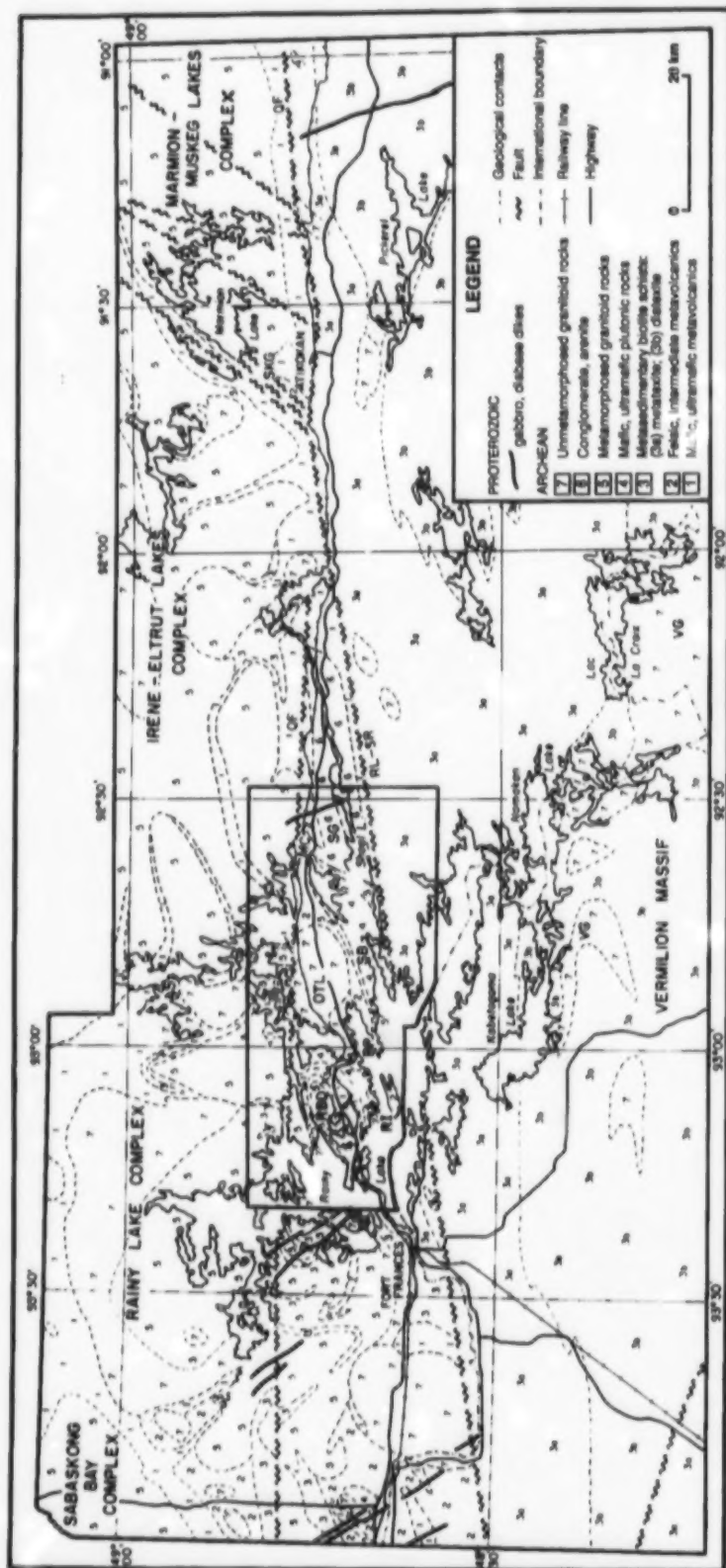


Figure 1. Regional geology along the Wabigoon-Quetico subprovince margin, Aitkirk-Fort Frances area of Ontario and adjacent parts of Minnesota. Heavy line outlines the area of the present study. Major features include the Sleep Rock Group (SKG), Seine metasediments (SG), Vermilion granite (VG), Rice Bay Dome (RBD), Bear Passage (BP), Ottertail Lake (OTL), Seine Bay (SB), Mine Centre (MC), Quetico Fault (QF), and Rainy Lake-Seine River fault (RL-SR).

Table 1. Summary of geochronological data from Rainy Lake and surrounding areas.

Lithologic Units	K-Ar	Method/Age (Ma) Rb-Sr	U-Pb	Reference
Wabigoon Subprovince				
Batholith Complexes:				
Sabaskong:				
granodiorite gneiss	2580 (Bi)			Peterman et al. 1972
hornblende biotite	2752 (Zi)			Davis et al. 1980
trondhjemite				
Rainy Lake:				
total complex (pooled)		2561±66 (9,WR)		Birk 1979
Stocks, Small Granitoid Intrusions:				
Phinney-Dash Lake (trondhjemite)		2732.1±2.3(Zi)		Davis et al. 1980
Burditt Lake		2543±45(9,WR)		Birk and McNutt 1981
Essex Lake		2518±42(4,WR)		Birk and McNutt 1981
Ryckman Lake		2554±63(7,WR)		Birk and McNutt 1981
Barwick				
(gneissic quartz monzonite)	2390 (Bi)			Peterman et al. 1972
Mine Centre-Fort Frances				
Metavolcanic Rocks	2380(WR)	2540±45(WR)	2670	Peterman et al. 1972
Metasedimentary Biotite Schists		2690(Mu)	2670	Peterman et al. 1972
Metamorphosed Granitoids:				
Bad Vermilion intrusion		2467 (WR)	2670	Hart and Davis 1969
Grey gneiss, Rice Bay	2680(Mu)	2560 (WR)	2670	Peterman et al. 1972
Unmetamorphosed Granitoids:				
(pooled)		2485±90(WR)	2670	Peterman et al. 1972
Rest Island		2403±104(WR)		Birk and McNutt 1981
Ottetail Lake		2461±78(WR)		Birk and McNutt 1981
Bear Passage		2654±158(WR)		Birk and McNutt 1981
	2540(Mu)			Peterman et al. 1972
Quetico Subprovince				
Quetico Metasediments:				
Biotite schist (Sapawe)	2460(Bi)			Peterman et al. 1972
Migmatites, Gneisses:				
quartz-oligoclase-				
microcline-muscovite-	2630(Mu)	2640(Mu)		Peterman et al. 1972
garnet gneiss (Sapawe)				
Granitoids:				
Vermilion granite		2625±95(10)		Peterman et al. 1972
(two samples from Rainy Lake area)				
Zi = zircon mineral ages Bi = biotite mineral ages Mu = muscovite mineral ages WR = whole rock ages				

Note: Numbers in parentheses indicate number of samples analyzed

REGIONAL DISTRIBUTION OF MINERALIZATION

The Atikokan-Fort Frances area of Ontario and adjacent parts of Minnesota were the site of intensive prospecting for gold in the 1890s. Gold production from small mines in the interval 1893 to 1902 came principally from 2 areas: Mine Centre and Atikokan (Figure 2). These were known as the Lower Seine and Upper Seine gold regions, respectively. Total production at that time and during subsequent activity reached 25 000 ounces of gold and 3000 ounces of silver. The deposits are concentrated along the subprovince boundaries and are related spatially to the major faults and their splays.

In the early part of the twentieth century, some exploration for iron in this region resulted in limited production from the Atikokan iron mine, near Sapawe, between 1907 and 1911. The major iron ore deposits at Steep Rock Lake

were developed during World War II and production began in 1945, continuing until 1979. Low-grade iron formations are also common in the region and tend to be concentrated near the subprovince boundaries.

Several significant prospects containing base metals have also been discovered. Two broad types are present: zinc-copper mineralization occurs at specific horizons within metavolcanic successions, and copper-nickel mineralization is associated with mafic and ultramafic rocks, particularly intrusions. Although some of these prospects have been extensively developed, very limited base metal production has been reported from this region.

Clearly there is a strong spatial correlation between known mineralization and the subprovince boundary. In particular, mineralization representing all of the above types is concentrated within the boundary zone in the Rainy Lake area, and is the subject of this publication.

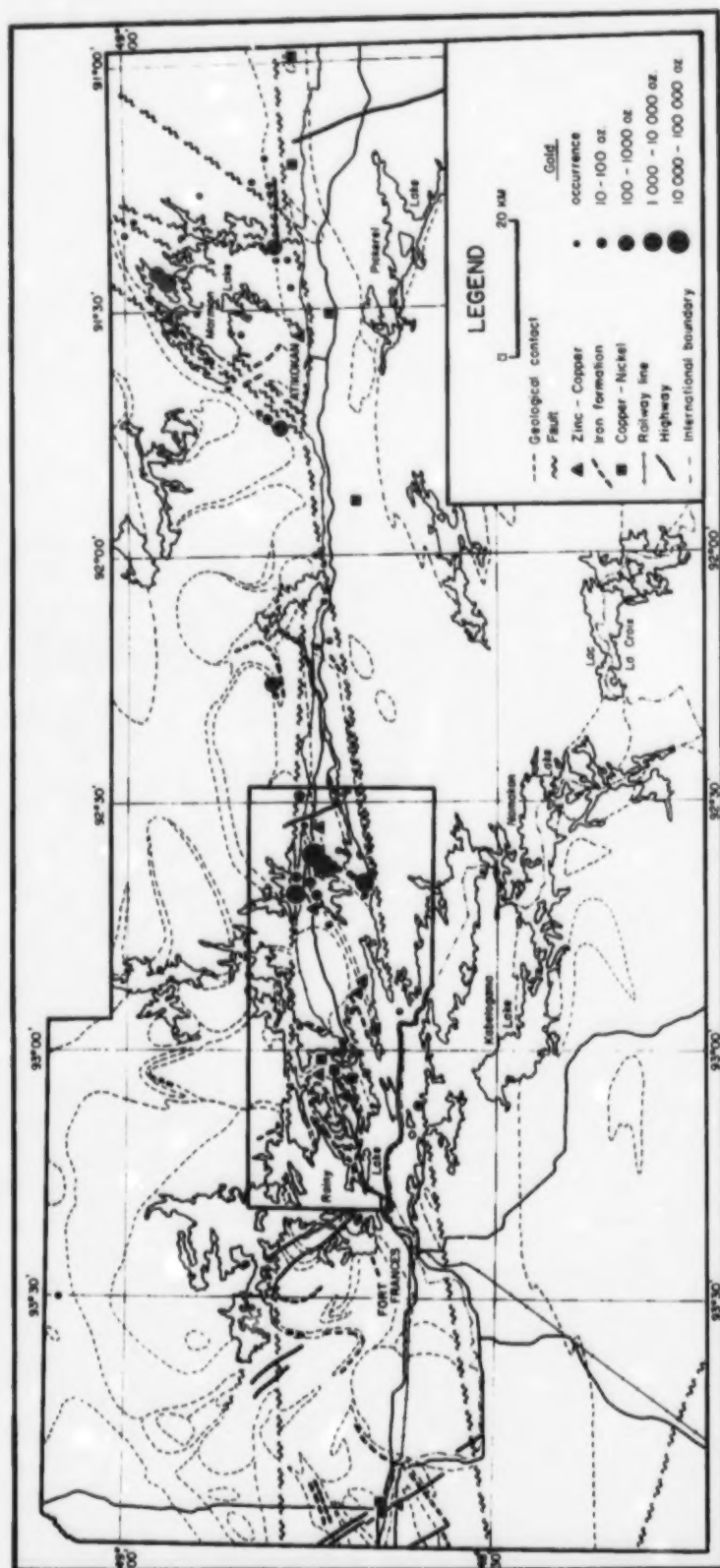


Figure 2. Distribution of mineralization along the Wabigoon-Quetico subprovince margin, Aitikokan-Fort Frances area of Ontario and adjacent parts of Minnesota. Heavy line outlines the area of the present study. Other symbols and rock types as in Figure 1.

General Geology

STRATIGRAPHY

The stratigraphy of Archean rocks at Rainy Lake has long proved to be a source of controversy. The mapping of Lawson (1913) established a stratigraphic nomenclature that included the dominantly metavolcanic Keewatin Group, metasedimentary biotite schists of the Couchiching Group, and the conglomerate-bearing Seine Group. Using the principles of structural superposition, Lawson interpreted the Couchiching Group to be the oldest, followed in turn by the Keewatin Group and the Seine Group. With the exception of disagreement by Grout and his co-workers (Grout et al. 1951), this stratigraphic interpretation has prevailed until recently (Poulsen 1980a; Wood et al. 1980a, 1980b). Unfortunately, previous interpretations were based on observations around the Rice Bay Dome where it can be shown that structural superposition is not a valid stratigraphic tool. A revised stratigraphic column (Table 2) is based upon data obtained from recent mapping by the Ontario Geological Survey (Harris 1974; Poulsen 1980b; Wood et al. 1980a, 1980b; Poulsen 1981). The spatial distribution of the units is shown in Figure 3 and on Map 2525 (back pocket). Several of the units are confined to particular fault-bounded blocks; stratigraphic extrapolation between blocks is unwarranted.

Mafic Metavolcanic Rocks

Metamorphic rocks with compositions of andesite to basalt are common, both as a dominant rock type and intercalated with felsic, intermediate and ultramafic rocks. In the greenschist facies, chlorite is the dominant component, while in the amphibolite facies both hornblende-rich (iron-rich) and actinolite-rich (magnesium-rich) types are found. Pillowed flows are moderately common, and the local presence of varioles, metamorphosed hyaloclastite and amygdules has been noted.

Intermediate Metavolcanic Rocks

An elongate unit, in which rocks of dacite to andesite bulk composition are common, extends northeastward from Sandpoint Island to Mine Centre (see Figure 3). It includes intercalated mafic and felsic metavolcanic rocks in addition to those of intermediate composition. Chloritic clastic rocks and amygdaloidal flows are common, while pillowed flows are rare, particularly near Mine Centre. This may reflect a shallow water to subaerial depositional environment for that area. The top of the Sandpoint Island-Mine Centre unit is occupied by a distinctive autoclastic chloritic breccia, which is directly overlain by felsic metavolcanic rocks. To the north and west of the Rice Bay Dome (see Figures 1 and 3), highly deformed quartz-biotite amphibolites retain relict clastic structures and are provisionally interpreted to be similar to the intermediate units at Mine Centre.

Felsic Metavolcanic Rocks

Flows and fragmental rocks of rhyolite to dacite bulk composition are exposed in a continuous unit extending from the Seine Bay area northeastward through Mine Centre and past the eastern margin of the map area (see Figure 3). Flows are common, particularly in the Mine Centre area where the thickest accumulation of felsic rocks is recorded. Volcanic structures are common and include flow laminations, autobreccias and spherulites. Southwestward from Mine Centre the felsic sequence thins gradually, with tuffs and lapilli tuffs forming a greater proportion of the unit. These rocks are interpreted to have formed relatively more distant from a centre of volcanism than those at Mine Centre. Felsic rocks also occur intercalated with mafic and intermediate rocks at lower stratigraphic levels. Elsewhere, minor amounts of felsic metavolcanic rocks have been observed west of Rice Bay, south of Ottertail Lake and in a narrow unit extending eastward from the northeast corner of Shoal Lake; these units are of limited extent and are not distinguished on Map 2525. The schistose rocks exposed within the core of the Rice Bay Dome also retain some evidence of a felsic volcanic protolith (see "Metamorphosed Granitoid Rocks and Related Rocks").

Ultramafic Metavolcanic Rocks

A unique ultramafic unit occurs in the Redgut Bay-Grassy Portage Bay area (see Figure 3). Rocks from this unit have distinctive textures as well as chemical compositions (42% SiO₂, 6% Al₂O₃, 21% MgO). Locally, the rock consists of angular to subrounded fine-grained clasts, up to 5 cm in diameter, set in a fine-grained tremolite-rich matrix. The rocks are moderately to strongly magnetic and, where visible fragments are not present, are fine-grained magnetic tremolite schists. As a whole, this ultramafic unit strongly resembles the "ashrock" unit that overlies the iron ore horizon of the Steep Rock Group (Joliffe 1955) north of the Quetico Fault at Atikokan, 100 km to the east.

Metamorphosed Chemical Sedimentary Rocks and Intercalated Clastic Rocks

Iron-bearing chemical metasedimentary rocks are common constituents of the volcanic sequences, particularly those dominated by mafic and ultramafic metavolcanic rocks (see Figure 3). The ironstones include magnetitic chert, pyritic slate, massive pyrite-pyrrhotite lenses and minor pyrrhotite-bearing marble. Chert occurs without ironstone as beds intercalated with siltstone at the top of the felsic metavolcanic succession along the southern shore of Swell Bay. Clastic metasedimentary rocks are associated with most occurrences of chemical metasediments and include siltstones, slates and siliceous biotite schists.

Table 2. Lithologic units of the Mine Centre-Fort Frances area, Rainy Lake.

PHANEROZOIC

CENOZOIC

QUATERNARY

RECENT

Lake, stream and swamp deposits

PLEISTOCENE

Till, sand, gravel and lake deposits

PRECAMBRIAN

PROTEROZOIC

Fault Rocks

Schists, mylonites, cataclasites developed in heterogeneous rock types

Dike Rocks

Diabase, gabbro, lamprophyre, quartz-feldspar porphyry

ARCHEAN

NEOARCHEAN

Unmetamorphosed Granitoid Rocks and Related Rocks

Granite, granodiorite, monzonite, monzodiorite, quartz monzonite, quartz monzodiorite

Metamorphosed Conglomerate and Sandstone

Conglomerate, arkose, subarkose, lithic arenite, lithic arkose

Metamorphosed Granitoid Rocks and Related Rocks

Tonalite, trondhjemite, granite gneiss, quartzofeldspathic gneiss^c

Metamorphosed Gabbroic Rocks

Gabbro, melagabbro, leucogabbro, anorthosite, quartz gabbro, quartz diorite, metadiabase^b, amphibolite

Metamorphosed Wackes and Mudstones

Biotite schist, biotitic siltstone, slate, wacke, mudstone, migmatite (biotitic paleosome)

Metamorphosed Chemical Sediments and Intercalated Clastic Rocks^a

Chert, chert-magnetite, magnetite, pyrite-pyrrhotite, pyritic slate, slate, siltstone, wacke, associated iron formation

Ultramafic Metavolcanic Rocks

Metamorphosed lapilli tuff, tuff, magnetic tremolite-chlorite schist

Felsic Metavolcanic Rocks^a

Metamorphosed rhyolite to dacite flows, amygdaloidal flows, tuff, lapilli tuff, lapillistone, agglomerate, quartz-sericite schist

Intermediate Metavolcanic Rocks^a

Metamorphosed andesite to dacite flows, pillowed and amygdaloidal flows, chloritic tuff, lapilli tuff, quartz-amphibole schist, agglomerate, breccia, quartz-chlorite schist, migmatite

Mafic Metavolcanic Rocks^a

Metamorphosed basalt to andesite flows, mafic tuff, amphibolite, chlorite schist, migmatite (amphibolitic paleosome)

Notes:

a While the table represents the broad stratigraphic order among these rock types, local intercalation of rock types is common.

b Sills of this type are common throughout the volcanic succession and constitute a substantial fraction of the total thickness of metavolcanic rock.

c This is not necessarily orthogneiss.

Metamorphosed Wackes and Mudstones

The rocks of this type have been referred to historically as the Coutchiching Group in the Rainy Lake region (Lawson

1913). Current appellation refers to them as Coutchiching metasediments. They form the bulk of the sedimentary component of the Quetico Subprovince to the south of the boundary zone where they are referred to informally as Quetico metasediments (Wood 1980). In addition, 2 exten-

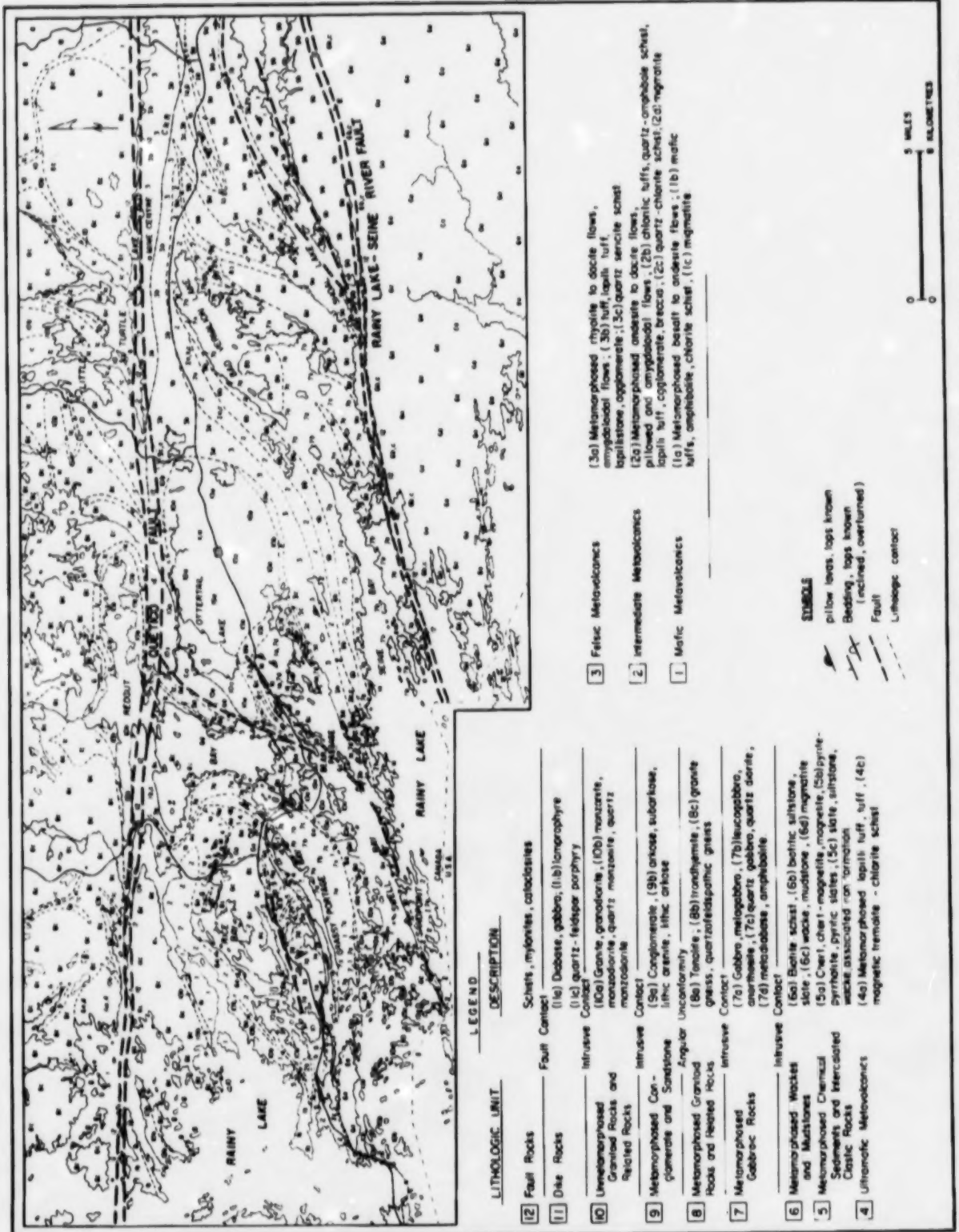


Figure 3. Generalized lithologic map of the Mine Centre-Fort Frances area. Based on mapping by Blackburn (1973), Harris (1974), Wood et al. (1980a, 1980b) and Poulsen (1980b, 1981).

sive units of similar lithologic composition occur north of the Rainy Lake–Seine River fault within the boundary zone: one encircles the Rice Bay domal structure, while the other extends through the islands of Swell Bay to Bear Passage and Ottertail Lake. At the Rice Bay locality, the meta-sedimentary rocks are metamorphosed to amphibolite facies assemblages and few primary structures are preserved. At Swell Bay, metamorphic grades are lower and massive beds, graded “abe” Bouma sequences, shale rip-ups and flame structures may be observed. Such primary features are also present in the Quetico metasediments (Ojakangas 1972; Wood 1980).

The Couchiching metasediments consist dominantly of feldspathic wacke and mudstone with rare feldspathic arenite and quartz arenite. Quartz clasts rarely show undulose extinction, low to intermediate anorthite compositions for plagioclase are common and rock fragments are rare. A volcanic provenance has been suggested (Ojakangas 1972), and at several key localities within the boundary zone, stratigraphic superposition of these rocks upon volcanic rocks has been demonstrated (Poulsen, Borradaile and Kehlenbeck 1980). Wood (1980) has emphasized, however, that predepositional reworking or a quartz-rich source area are required to explain the composition of these sedimentary rocks. Further, the precise structural and stratigraphic relationships between the Quetico metasediments and rocks of similar type within the boundary zone are uncertain due to the intervening Rainy Lake–Seine River fault.

Metamorphosed Gabbroic Rocks

Two large, steeply dipping, layered gabbroic sills, the Grassy Portage and Seine Bay–Bad Vermilion intrusions, are exposed within the boundary zone. Layering is expressed by modal variations in mineralogy, chemical variations across strike and locally by rhythmic mineral layering, which is well exposed in the Redgut Bay area. Rock compositions range from melagabbro to anorthosite, with plagioclase compositions in the range of An_{45-80} . Both intrusions display systematic internal variations in composition, which, when compared to other intrusions of similar type (Figure 4), suggest that the Grassy Portage intrusion faces southward while the Seine Bay–Bad Vermilion sill faces northward. Primary sedimentation features such as graded bedding and flame structures, exposed at a few localities in the Grassy Portage sill, support this interpretation.

Pillowed metabasalts are exposed within the central part of the Seine Bay–Bad Vermilion sill. These may be interpreted as large assimilated inclusions or, more likely, as interfingering country rock that separates 2 individual sills. Much of the base of the same intrusion is truncated by the Rainy Lake–Seine River fault, while the upper contact is occupied by a sill of trondhjemite (see Map 2525) of unknown genetic relationship to the gabbroic rocks. In addition to the large intrusions, numerous small sills and dikes cut the metavolcanic and metasedimentary sequence. They are commonly 50 to 100 m thick and are composed of

medium-grained, massive to strongly foliated amphibolite that locally resembles metadiabase. There is some compositional differentiation across the strike of many of the wider intrusions, with the development of quartz + plagioclase + magnetite accumulations toward the upper margins of the sills. Weak to moderate magnetism and irregular patches and veins of epidote-rich alteration are characteristic of these intrusions.

Metamorphosed Granitoid Rocks and Related Rocks

Historically, medium- to coarse-grained quartzofeldspathic rocks have been subdivided into 2 broad groups, the Algonian granites and the Laurentian granites of Lawson (1913). The former (unit 12, Map 2525) form discrete plutons and are relatively unmetamorphosed, while the latter (unit 9, Map 2525) are commonly foliated or lineated. While this criterion is satisfactory for field recognition, the metamorphosed Laurentian-type granitoid rocks possess other features that are equally diagnostic:

1. They tend to be relatively poor in potassium feldspar and relatively rich in quartz as compared to the Algonian-type granitoid rocks (Figure 5).
2. They form bodies that are broadly conformable with layering in enclosing country rocks.

There are 3 areas within the boundary zone in which significant volumes of this rock type are exposed: (a) the Bad Vermilion Lake–Mud Lake area; (b) the Rice Bay Dome area; and (c) the Black Sturgeon Bay area.

In the Bad Vermilion Lake–Mud Lake area, 2 extensive sills, the Mud Lake trondhjemite and the Bad Vermilion tonalite, as well as several smaller bodies, intrude volcanic and gabbroic rocks. The sills are conformable with their host rocks, and only rare dikes of similar granitoid composition have been observed cutting the country rocks. The trondhjemite is medium grained while the tonalite is coarse grained. Intensely foliated equivalents of both rock types are locally developed in shear zones.

In the Rice Bay Dome area, 3 specific rock types are present: quartz-plagioclase-mica schists and gneisses, quartz-poor mafic schists and gneisses, and dikes and sills of metamorphosed quartz-feldspar porphyry. The first is volumetrically dominant and has been variously interpreted as an orthogneiss (Lawson's (1913) Laurentian granite) or as a metasedimentary paragneiss (Peterman et al. 1972; Harris 1974; Goldich and Peterman 1980). Recent studies (Poulsen 1980a; Poulsen, Borradaile and Kehlenbeck 1980) indicate that the quartz-plagioclase-mica gneiss is texturally and compositionally distinct from both the metasedimentary rocks of the region and from those rocks that are clearly plutonic. Relict fragmental textures suggest a felsic volcanic origin for some of these rocks.

A pear-shaped body of granite gneiss approximately 10 km in diameter is exposed in the Black Sturgeon Bay–Northeast Bay area of Rainy Lake, to the northwest of Rice Bay. The body is texturally and compositionally heterogeneous, and is characterized by a strongly developed

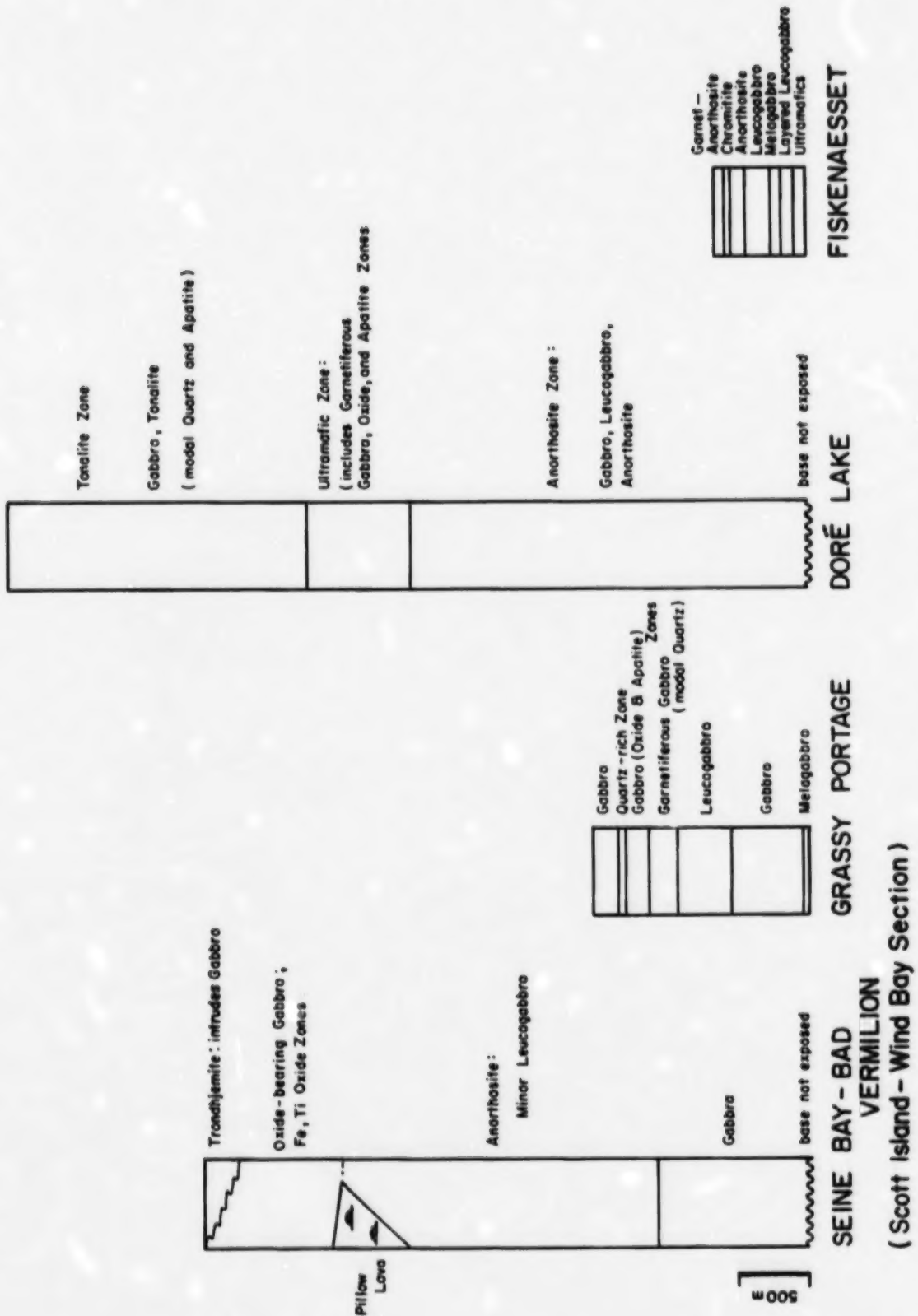
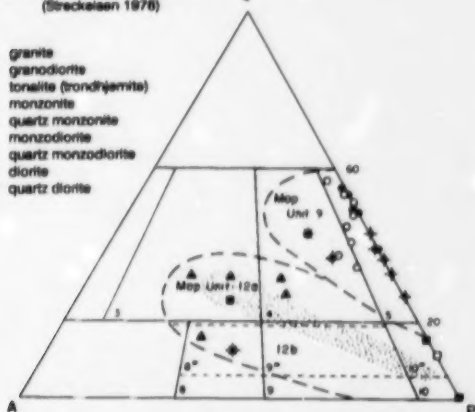


Figure 4. Comparative stratigraphic columns for Rainy Lake layered intrusions and similar examples at Doré Lake, Québec and Fiskeneasset, Greenland.

PLUTONIC ROCK CLASSIFICATION
(Streckeisen 1976)

- 3 granite
- 4 granodiorite
- 5 tonalite (trondhjemite)
- 8 monzonite
- 8* quartz monzonite
- 9 monzodiorite
- 9* quartz monzodiorite
- 10 diorite
- 10* quartz diorite



- Granitic gneiss (north of Quetico Fault; Blackburn 1973)
- ◆ Bad Vermilion tonalites (point-counted samples, Frye 1959)
- Mud Lake trondhjemite (point-counted samples, Frye 1959)
- Quartz-plagioclase-mica gneisses -- Rice Bay Dome (point-counted samples, Peterman 1959)
- ✱ Granitoid sills -- Rice Bay Dome (Harris 1974)
- ◆ Granite gneiss -- Hopkins Bay area (Harris 1974)
- Marginal phase -- Ottotail Lake intrusion (Harris 1974)
- ✱ Rocky Islet Bay complex (Harris 1974)
- Rocky Islet Bay (Frye 1959)
- ▲ Swell Bay "Algonian plutons" (Frye 1959)
- Range of compositions for Bear Pass and Ottotail Lake intrusions (Birk and Mohr 1981)

Figure 5. Compilation of modal data for granitoid rocks and related rocks, Rainy Lake area.

gneissic foliation, which parallels the foliation in adjacent country rocks.

Metamorphosed Conglomerate and Sandstone

Three areas underlain by conglomerate and sandstone are present: (a) north and east of Shoal Lake; (b) south and east of Shoal Lake; and (c) a narrow zone in the Rice Bay area. Historically, all of these rocks have been referred to as the Seine Group. Current appellation refers to them as Seine metasediments. North of Shoal Lake, conglomerate lies with angular unconformity on both coarse-grained tonalite (see Map 2525) and on intermediate metavolcanic rocks. A coarse boulder to granule conglomerate occupies the base of the sequence. In general, the Seine metasediments comprise clast-supported conglomerate, interbedded conglomerate and arenite, arenite, and minor siltstone. Relative abundance data for clasts of different compositions indicate the dominance of intermediate metavolcanic rocks (Figure 6). Framework clast sizes decrease with stratigraphic height (Wood 1980). Sandstone interbeds are relatively common, range up to 1 to 2 m in thickness and show either parallel lamination or low angle cross-stratification. Substantial volumes of trough-crossbedded sandstone occur without conglomerate. Compositionally these are lith-

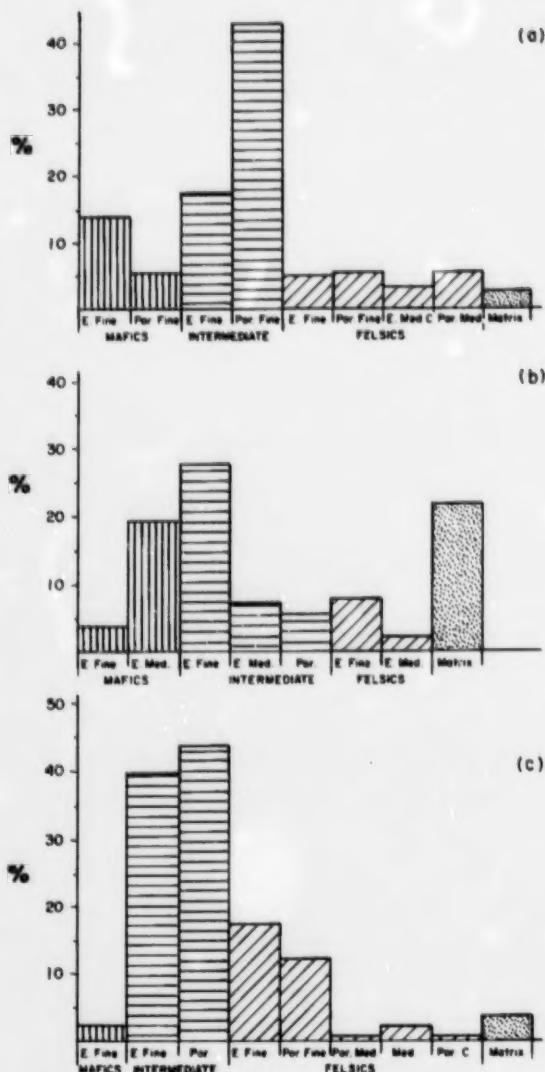


Figure 6. Histograms showing the frequency of occurrence of clasts of distinctive composition of the Seine conglomerate at three localities (after Wood 1980). E=equigranular, Por=porphyritic.

ic arenites, lithic subarkoses and arkoses (Wood 1980). Within the Seine metasediments there is a broad-scale transition from poorly sorted conglomerate, to sorted conglomerate with sandstone interbeds, to pebbly sandstones and trough-crossbedded sandstone. This unit has been interpreted to be an alluvial fan merging into a braided fluvial terrain (Wood 1980).

Unmetamorphosed Granitoid Rocks and Related Rocks

The rocks of this category, informally referred to as Algonian granites, possess a number of features that distinguish

them from their metamorphosed counterparts (unit 9, Map 2525):

1. They are compositionally different. These rocks contain less quartz and are commonly rich in potassium feldspar. They range in composition from diorite to granite (see Figure 5).
2. They are rarely foliated with the possible exception of marginal phases.
3. They form discrete discordant plutons that are elliptical to irregular in plan.
4. Agmatitic breccias are common at pluton margins. Xenoliths commonly consist of rotated blocks of regionally foliated country rock.

The above criteria suggest late- to post-tectonic emplacement of these granitoid rocks.

Dike Rocks

Throughout the map area dikes, sills and irregular masses of plutonic rock of highly variable composition are exposed. Most of these appear to be late-stage intrusions in their own local context. They include northwesterly strik-

ing Proterozoic diabase dikes, biotitic lamprophyres that are commonly xenolithic, and quartz-feldspar porphyries. While all of these form bodies that are similar in morphology and in their volumetric insignificance, they represent a wide spectrum in absolute ages and origins.

Fault Rocks

The two major faults, the Quetico and Rainy Lake-Seine River faults, consist of zones of deformed equivalents of most of the other rock types in the region. The Quetico Fault zone is up to 1 km wide and contains schists, mylonites, cataclasites and pseudotachylite. The protoliths are plutonic, metavolcanic and metasedimentary rocks that are tectonically intercalated to produce a heterogeneous sequence. The rocks of the Rainy Lake-Seine River fault zone are similarly developed from different lithologies. Here, schists, phyllites and phyllonites are very chloritic, and little distinction can be made between plutonic, volcanic or sedimentary protoliths. In addition to the large faults, smaller shear zones are developed throughout the study area. They are commonly composed of schists that have been derived from a local protolith.

Structure

The rocks of the Mine Centre–Fort Frances area contain evidence of progressive deformation involving folds, ductile shear zones and faults. While some of the above features likely formed contemporaneously, there is evidence of a continued transition from ductile to brittle deformation. The attitudes of most structures appear to be dominated by incremental shortening about a subhorizontal axis oriented west-northwest–east-southeast. This imparts a dominant northeasterly trending structural “grain” to the rocks of the area.

FOLDS, CLEAVAGE AND LINEATION

Variations in the distribution, attitudes and facing of mappable lithologic units attest to the existence of large folds within the study area (Figure 7). One of these, the Rice Bay Dome, is not a simple structure but can be related to the development of 3 distinctive fold sets (Poulsen, Borradaile and Kehlenbeck 1980). New lithologic mapping of the magnetic ultramafic unit exposed in this area has resulted in further definition of these folds. Early folds (F_1) were recumbent and involved substantial inversion of the stratigraphic succession. An early foliation (S_1), recognized locally by extreme flattening of pillow lavas, is probably related to D_1 . Refolding about axes (F_2) that are confined to an east-northeast-striking axial surface (S_2) produced a complex interference structure (Figure 8). This superposition results in F_2 folds that face structurally downward onto the dome. D_2 structures are common and small F_2 folds are locally coaxial with pronounced lineations (L_2) which result from crystallographic and dimensional orientation of metamorphic minerals. Cleavage (S_2) that is axial planar to F_2 folds is generally well developed. A third fold set (F_3) is accompanied by the development of kink bands and a crenulation cleavage (S_3) that strikes northwest. D_3 minor structures are particularly abundant in the Bear Passage area.

Away from the Rice Bay Dome, similar sets of minor structures can be recognized. Rarely, 3 discrete cleavages have been observed in a single outcrop. While direct temporal correlation of such cleavages with similar structures in the Rice Bay Dome is unwarranted, the persistence of east-northeast and northwesterly striking sets throughout the area suggests a genetic relationship to a west-northwest-oriented axis of shortening. These cleavages are commonly axial planar to small folds but their direct relationship to big folds is more ambiguous. In some cases, they appear to transect large structures defined by younging reversals, implying the possible existence of early fold sets such as that mapped at Rice Bay. Minor fold axes and lineations are found to have variable attitudes, but shallow plunges on east-northeast and west-southwest trends are common. Near-vertical stretching lineations are well developed west of the Rice Bay Dome.

SHEAR ZONES AND FAULTS

The attitude of minor fold axes and cleavage are clearly controlled by proximity to the Quetico and Rainy Lake–Seine River faults (see Figure 7). The sigmoidal pattern of cleavage orientation suggests that these faults involve a zone of ductile deformation in which rotation of early-formed structures has taken place. Deflection of marker units indicates right-hand components of displacement for both faults so that the intervening terrane can be considered to be a dextral wrench zone (Figure 9). The orientations and senses of mesoscopic ductile shear zones across the area support this interpretation. Three common orientations exist: 2 sets of right-hand shear zones parallel to each of the major faults can be distinguished from a northwesterly striking, left-hand conjugate set (see Figure 9). The interpreted direction of regional shortening (see Figure 9) is consistent with that indicated by the folds (see Figure 7).

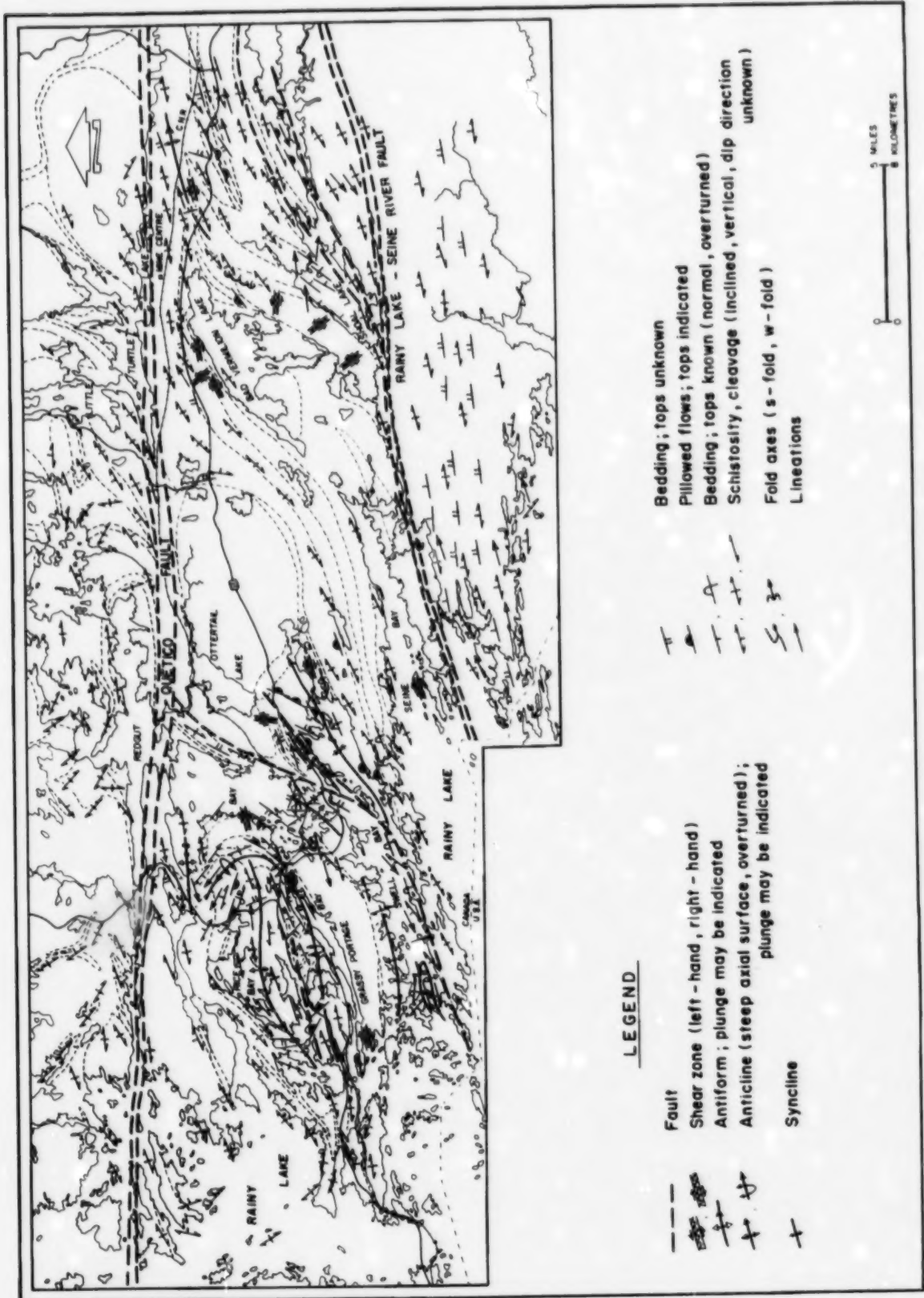


Figure 7. Summary diagram showing the orientation of fabric elements relative to major structural features, Mine Centre-Fort Frances area.

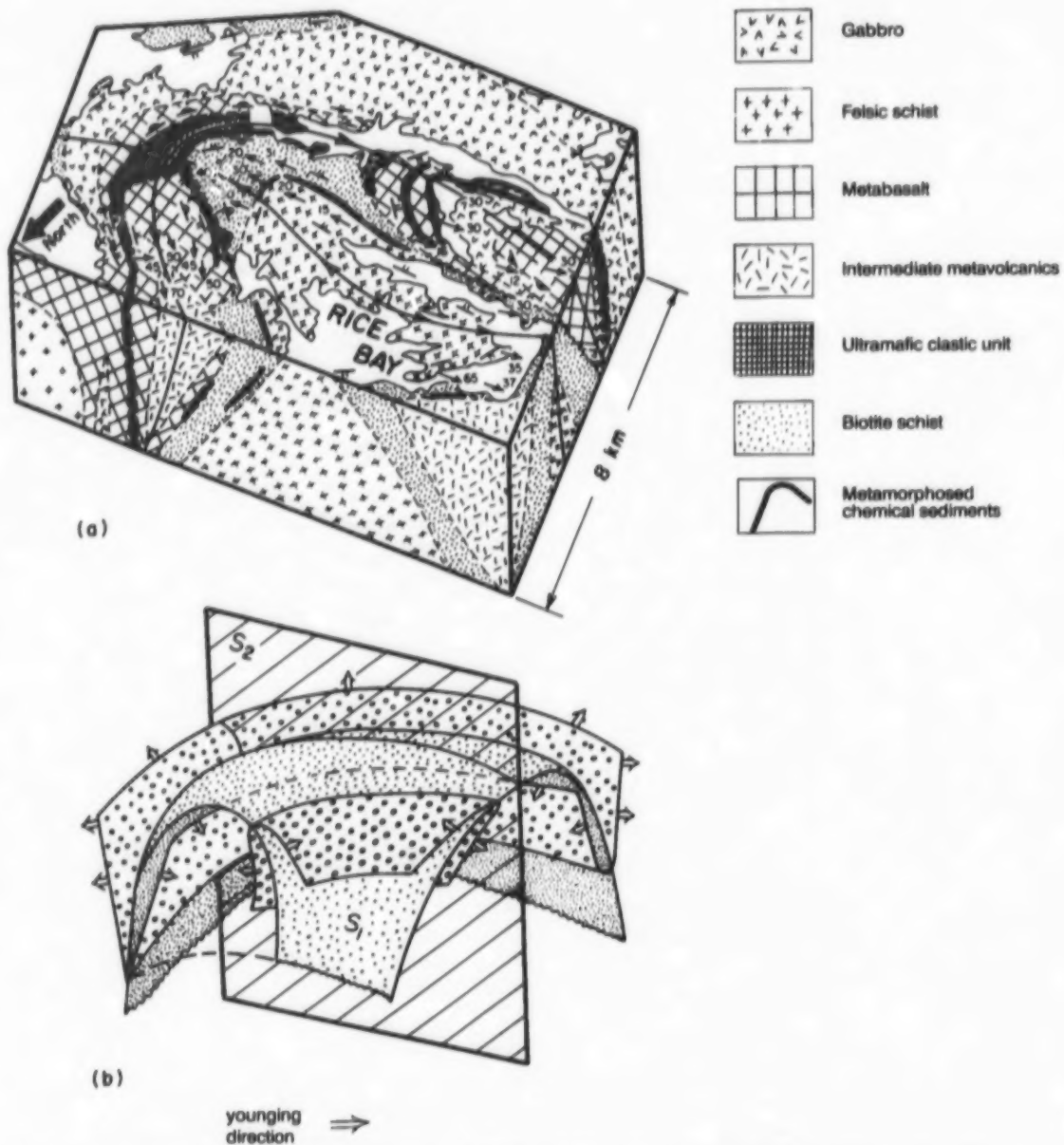


Figure 8. a) Block diagram summarizing the geology near the Rice Bay Dome. See Map 2525 (back pocket) for standard structural symbols. b) Schematic diagram illustrating the form of folds necessary to satisfy the observations in Figure 8a. S_1 (stippling) and S_2 (diagonal lines) are indicated. This is but one possible interpretation of the data.

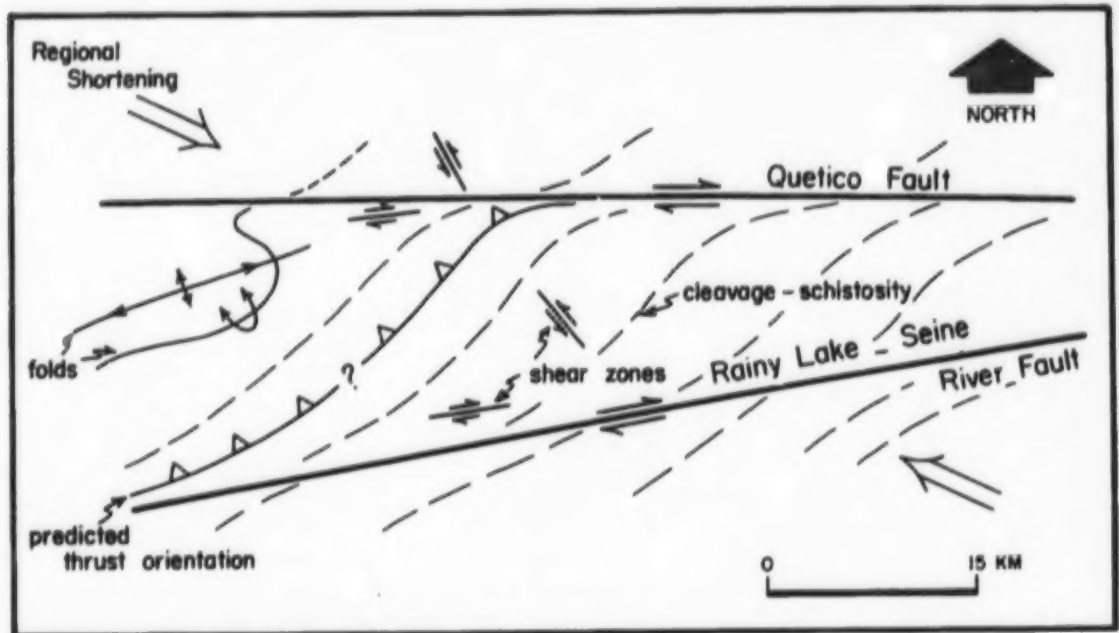


Figure 9. Schematic diagram illustrating an interpretation of the main structural features of the Mine Centre-Fort Frances area. Regionally developed cleavage, east-northeast oriented folds, conjugate ductile shear zones and the main boundary faults are compatible with regional shortening about a subhorizontal northwesterly directed axis.

Metamorphism

The rocks of the Mine Centre-Fort Frances area contain metamorphic mineral assemblages that are diagnostic of the greenschist and amphibolite facies. The petrographic study of metapelites, metabasites, altered felsic metavolcanic rocks and metamorphosed impure dolomites (Table 3) has enabled the author to define a metamorphic boundary between the two facies (Figure 10). While this boundary is not in the strictest sense an isograd, it does correspond broadly to a number of closely spaced metamorphic reactions in P-T (Pressure-Temperature) space (Figure 11). It represents the first appearance of porphyroblasts in metapelites and the conversion of metabasites from chlorite schists to amphibolites. Sillimanite is present with muscovite, garnet and biotite in the northwestern part of the area and a provisional further subdivision of amphibolite facies rocks into 2 zones is possible (see Figure 10). The distribution of the metamorphic facies is controlled locally by the unmetamorphosed intrusions but, on a larger scale, is independent of pluton margins. Thus the metamorphism may be considered to be of a regional nature with local contributions from contact metamorphism.

The conditions of metamorphism can be estimated by considering some of the important assemblages that have been observed:

1. Cordierite + anthophyllite is developed in the contact aureole of the Ottertail Lake pluton. The assemblage

is formed in the andalusite stability field and on the low temperature side of the garnet + muscovite + sillimanite zone boundary. This combination suggests pressures of 2 to 3.5 kilobars and temperatures in the 500 to 550°C range (see Figure 11).

2. Low-grade altered felsic metavolcanic rocks in the Shoal Lake area contain the assemblage chloritoid + chlorite + muscovite + quartz + calcite. This assemblage suggests temperatures of less than 450°C and pressures greater than 2 kilobars (see Figure 11), although the latter constraint is not well defined.
3. On the southern side of Redgut Bay, an assemblage consisting of staurolite + garnet + biotite + magnesium chlorite + andalusite + sillimanite with rare muscovite has been noted. If this is considered to be an equilibrium assemblage, a diagnostic minimum pressure of 3 kilobars is indicated at a temperature of approximately 550°C (Holdaway triple point; Holdaway 1971).

The above data are consistent with an interpretation of essentially isobaric metamorphism in the temperature range of 400 to 600°C. Textural evidence shows that while metamorphism was contemporaneous with deformation, the peak of metamorphism postdated the formation of major folds and the bulk of rock cleavage.

Table 3. Metamorphic mineral assemblages, Mine Centre-Fort Frances area.

Greenschist Facies	
Metabasites	: chlorite + albite + quartz + carbonate + magnetite chlorite + epidote + quartz + carbonate + magnetite
Altered metavolcanics	: quartz + chlorite + sericite + albite chloritoid + chlorite + sericite + quartz + carbonate
Metapelites	: quartz + albite + muscovite + chlorite quartz + biotite + muscovite + chlorite + albite
Amphibolite Facies	
Metabasites	: hornblende + plagioclase + quartz + epidote + sphene actinolite + magnesium chlorite + talc + magnetite actinolite + magnesium chlorite + quartz hornblende + epidote + biotite + plagioclase + quartz
Altered metavolcanics	: cordierite + anthophyllite + chlorite (retrograde assemblage)
Metapelites	: garnet + staurolite + magnesium chlorite + biotite + plagioclase + quartz garnet + staurolite + magnesium chlorite + biotite + andalusite + quartz garnet + staurolite + magnesium chlorite + biotite + sillimanite + andalusite + quartz staurolite + andalusite + biotite + quartz muscovite + garnet + biotite + sillimanite
Impure marble	: calcite + diopside + garnet + epidote

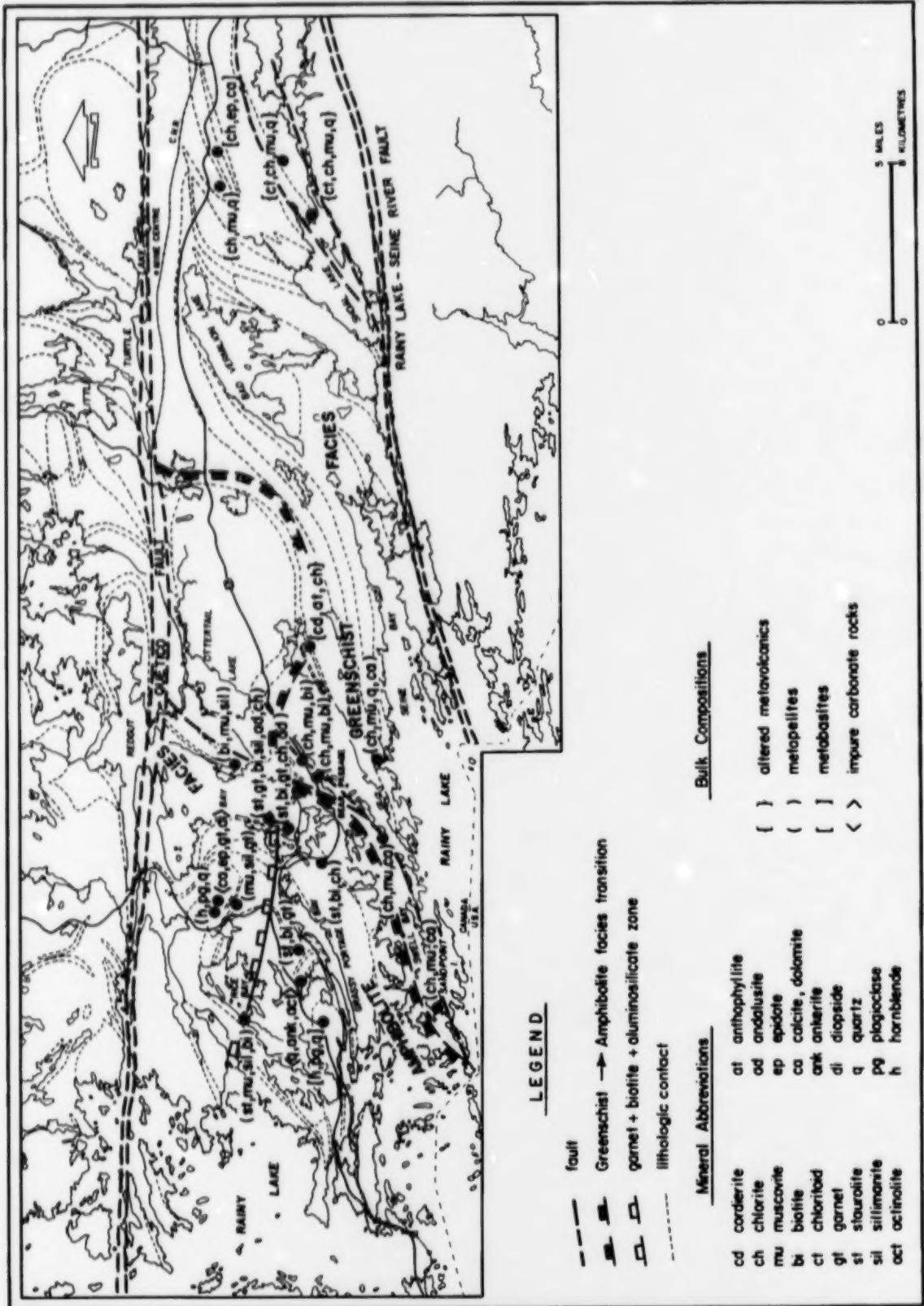


Figure 10. Summary metamorphic map for the Mine Centre-Fort Frances area.

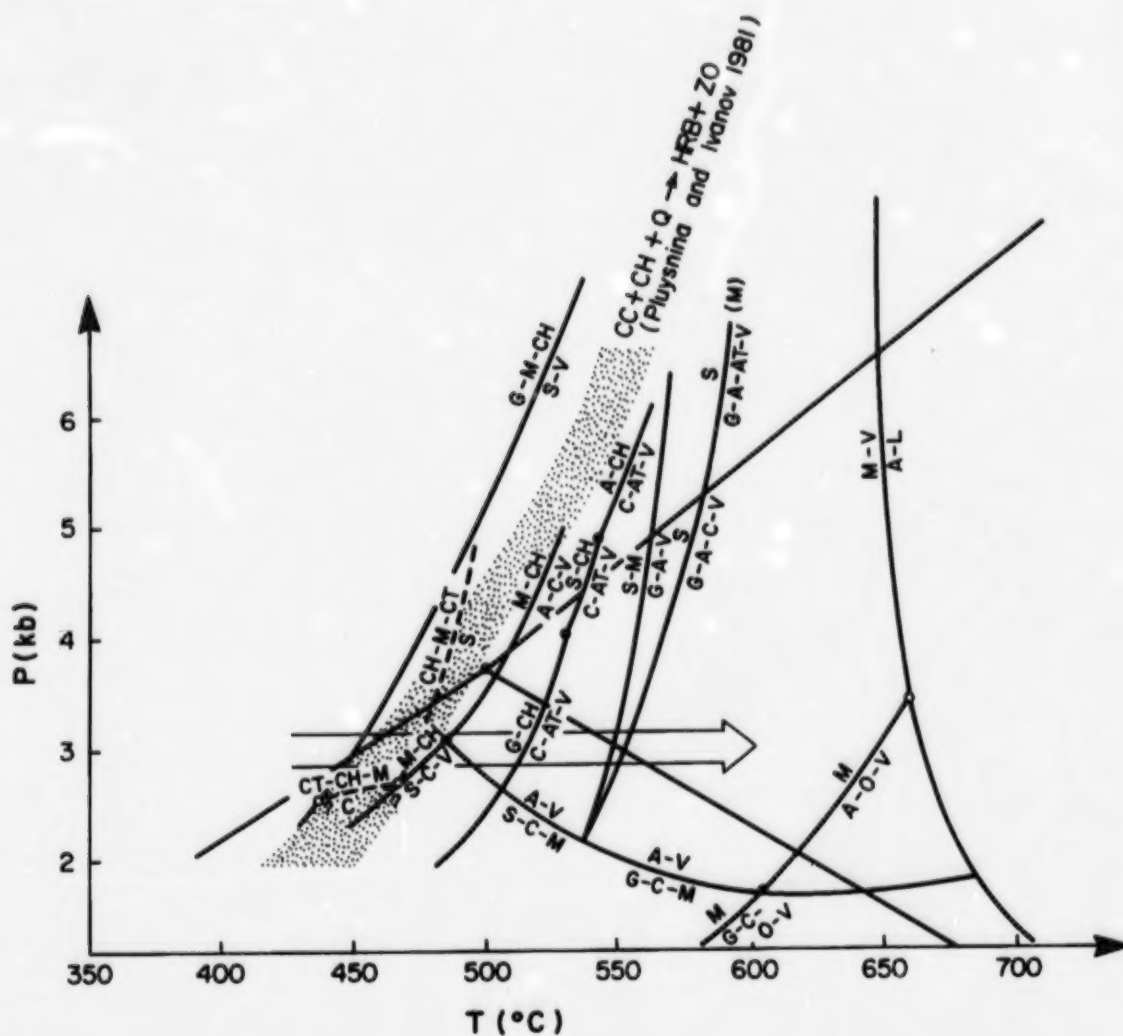


Figure 11. Pressure-temperature diagram illustrating the interpreted conditions of metamorphism for rocks in the Mine Centre-Fort Frances area. G=garnet, M=muoncovite, CH=chlorite, S=sillimanite, CT=chloritoid, C=cordierite, A=andalusite, O=orthoclase, AT=anthophyllite, CC=calcite, Q=quartz, HRB=hornblende, ZO=zoisite, V=vapour, L=liquid.

Geochemistry

Three types of geochemical data have been reported for rocks of the boundary zone in the Mine Centre–Fort Frances area:

1. reconnaissance whole rock analysis aimed at classification and preliminary interpretation of plutonic, volcanic and sedimentary rock types;
2. isotopic data used for geochronological and petrogenetic interpretation;
3. trace element and rare earth element geochemical data obtained for petrogenetic modeling of igneous rocks.

Whole rock geochemical data for rocks from the Mine Centre–Fort Frances area (Goldich and Peterman 1980; Poulsen 1980a) are summarized in Figure 12. Clearly, a wide range of compositions is present in both the volcanic and plutonic suites. Goldich and Peterman (1980) have emphasized the bimodal distribution of the "Keewatin" volcanic rock suite; however, more data are required to evaluate this possibility. The major element data (see Figure 12) emphasize the iron-rich nature of both felsic and mafic volcanic components in addition to a clear separation of volcanic and plutonic rock compositions. The ultra-

mafic volcanic rocks are compositionally similar to komatiites but they possess unusually high TiO_2 contents of up to 1.5% (Poulsen 1980a). Goldich and Peterman (1980) attribute the observed diversity of bulk compositions to different source materials and degrees of melting, to fractional crystallization and to crustal contamination.

Abundant isotopic data are available for Rainy Lake rocks from the boundary zone. Geochronological results (Hart and Davis 1969; Peterman et al. 1972; Birk and McNutt 1981) are summarized in Table 1. A wide range of ages (2700 to 2400 Ma) has been observed. The oldest zircon ages at approximately 2700 Ma are thought to represent a period of widespread igneous activity throughout the Wabigoon Subprovince. The 2600 Ma zircon ages for volcanic rocks (Goldich and Peterman 1980) are somewhat younger than those reported for other Wabigoon belt meta-volcanic rocks (Davis et al. 1980). Isotopic data have also been used for petrogenetic interpretation. Low values for oxygen isotopic composition and initial strontium ratios for the Ottertail Lake, Rest Island (near Sandpoint Island) and Bear Pass plutons indicate a lower crust or mantle source for these unmetamorphosed granitoid rocks (Longstaffe and Birk 1981).

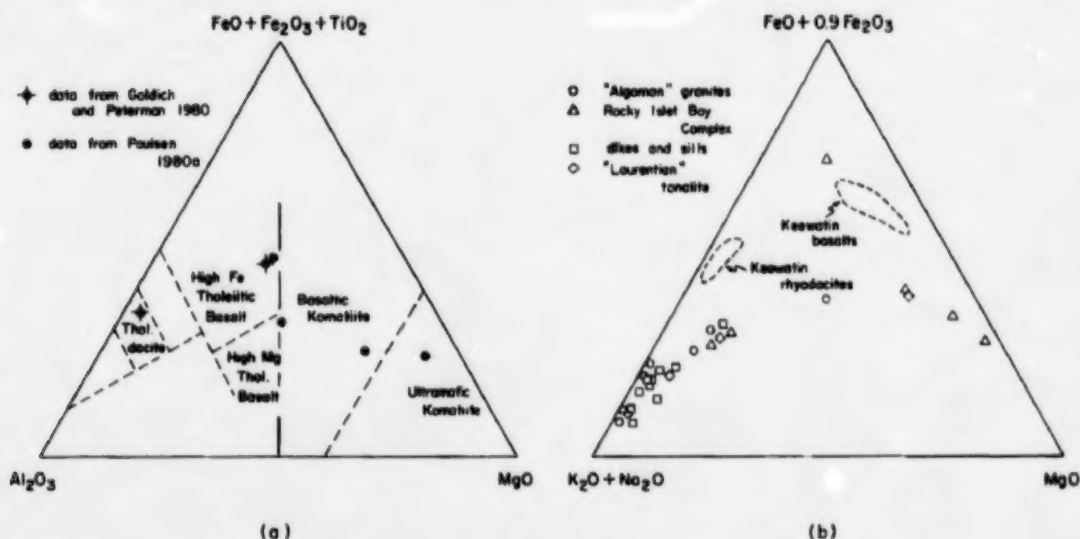


Figure 12. Plots of whole rock geochemical data for a) volcanic rocks in the Mine Centre–Fort Frances area (Thol = tholeiitic) and b) plutonic rocks in the Mine Centre–Fort Frances area.

Mineral Deposits Classification

The Rainy Lake area has a long history of mineral exploration and exploitation since the discovery of gold at Mine Centre in 1893. At that time, 3 deposits, the Olive, Golden Star and Foley mines were worked and, coupled with renewed activity during the 1930s, a total production of approximately 485 kg of gold and 20 kg of silver was realized (Beard and Garratt 1976).

The noted similarity of iron formations at Nickel Lake to those at Michipicoten, about 630 km to the east-southeast, led to exploration in the area around the turn of the century. Diamond-drill programs in 1920 and 1955 defined a minimum of 2 000 000 t of magnetite-ilmenite mineralization hosted by anorthosite and gabbro north of Seine Bay (Rose 1969).

Since the mid 1950s, exploration in the region has been focused largely on the search for base metals. The discovery of copper in gabbro at Grassy Portage Bay in 1958 led to the development of a 70 m, two-compartment shaft and a 200 m drift through the mineralization by North Rock Mines Limited in 1973. Recent exploration programs have investigated zinc-copper mineralization hosted by metavolcanic rocks. Numerous occurrences have been evaluated by diamond drilling and geophysical methods but, to date, no economically viable deposits have been outlined.

In total, 89 individual mineral properties have been developed to various degrees. Recent mapping by the Ontario Geological Survey (Poulsen 1980b, 1981) was initiated to identify the geological settings of the different mineralization types with an objective of establishing exploration criteria for this area. All significant occurrences of mineralization have been considered in terms of stratigraphic setting, mineralogy and deposit morphology. These characteristics form the basis of the deposit classification shown in Table 4. Scattered minor occurrences, on which there has been no development, have been noted but are not included in the table. The spatial distribution of selected deposits is shown in Figure 13, which also gives a numerical listing of properties as classified by size.

Descriptive aspects for each deposit type may be illustrated by data from all occurrences of that class with particular emphasis on the largest and most completely developed properties.

TYPE 1: METAVOLCANIC-HOSTED MINERALIZATION

Zinc-copper mineralization at Rainy Lake occurs in a number of specific volcanic environments. The mineralization at Gagne Lake (Type 1A) consists of lenses of massive sphalerite and galena as wide as 20 cm, which parallel similar overlying pyritic layers. Chemical analysis of the base metal sulphides revealed anomalous concentrations of tin. Rocks of the footwall to the south of the mineralized

zone consist dominantly of rhyolitic lapillistone that locally contains a distinctive spotted alteration ("dalmatianite") of chlorite and centimetre-sized porphyroblasts of pinitized cordierite. The hanging-wall rocks consist of fine-grained siltstone and chert that locally form a coarse breccia with clasts as large as 50 cm in diameter. On strike with the mineralization, the breccia contains clasts of massive pyrite. Although drilling to date by G. Armstrong and M. Hupchuk has shown the mineralization to be very thin, the geological setting and alteration show a resemblance to many volcanogenic massive sulphide deposits (Sangster 1972).

Mineralization at the Pidgeon property occupies a similar setting. Here, *en échelon* lenses of sphalerite-galena-chalcopryite with iron carbonates are conformable with siliceous metavolcanic rocks. A diamond-drill intersection of approximately 2 m true width yielded assays of 0.53% Zn and 1.76% Pb. Low silver values up to 0.3 ounce per ton have been reported from sulphide-rich material. Pyritic blebs in felsic lapilli tuff typify the zones of footwall alteration, which are laterally more extensive than individual sulphide lenses.

Although the mineralogy of the Type 1B occurrences (sphalerite, pyrite, pyrrhotite, chalcopryite, minor galena) is similar to that of the massive sulphide deposits (Type 1A), this type of occurrence possesses a number of distinctive characteristics. Firstly, the host rock is commonly an amygdaloidal brecciated intermediate to mafic metavolcanic rock; secondly, the mineralization occurs as discrete seams, 1 to 20 cm wide, that are separated by substantial widths (1 to 20 cm) of barren chloritic host rock.

At the Wind Bay property, a typical drill section through 50 m of tuffaceous chlorite schist yielded 2 mineralized zones, 7 m and 8.6 m in true width, that averaged 1.5% Zn, 0.2% Cu and 1.1% Zn, 0.09% Cu, respectively (G. Armstrong, Prospector, personal communication, 1980). Where the quartz-chlorite schist is only weakly deformed, primary features such as angular fragments and amygdules are recognizable, suggesting protoliths were volcanic flows and tuffs. The distinctive chlorite schist unit is underlain to the south by rhyolite lapillistone and tuff, which contains alteration consisting of abundant pyrite and pyrrhotite blebs with minor chalcopryite near the contact. The chlorite schists are overlain by relatively unaltered quartz-eye rhyolite tuffs. The stratigraphic succession and, locally, the mineralized zones, are dissected by 3 laterally extensive mafic sills, which are slightly discordant to the strike of the metavolcanic rocks.

At the Port Arthur Copper Co. Mine, the stratigraphic setting of the mineralization is virtually identical to that at Wind Bay. Here, the amygdaloidal and brecciated nature of the chloritic host rock is clearly evident. Diamond drilling by Stratmat Limited revealed a zonal arrangement of copper and zinc within the host rock (Figure 14). Zinc-rich zones are underlain to the south by copper-rich mineraliza-

Table 4. Mineral deposits classification, Mine Centre-Fort Frances area.

Type 1: Stratabound Mineralization Hosted by Felsic to Mafic Metavolcanic Rocks

- A: Sphalerite-galena-chalcopryite associated with siliceous volcanic rocks - (Golden Star Mine (1)); Gagne Lake prospect (37); Hanna prospect (50); Pidgeon prospect (51).
- B: Sphalerite-chalcopryite associated with intermediate to mafic amygdaloidal volcanic flows, tuffs and breccias - Port Arthur Copper Co. Mine (4); Stratmat-Copperlane prospect (16); Ronda-Satellite prospect (17); Wind Bay prospect (38); Lochart Lake prospect (39); Farrington Boundary prospect (40); (Blondeau-Merryth prospect (49)); Hickerson occurrence (59); Mathieu occurrence (67); Anomaly 44A occurrence (69); Barber Lake base metal occurrence (70).
- C: Sphalerite-chalcopryite associated with iron formation - Pocket Pond prospect (24); McTavish prospect (26); Paramaque prospect (27); Nickel Lake prospect (28); Daley-Galbraith prospect (29); Sims Station prospect (30); Rocky Islet Bay prospect (33); Ottotail Lake prospect (35); Moosehorn occurrence (82).
- D: Lean iron formation - mainly chert-magnetite and massive pyrite-pyrrhotite, minor chalcopryite common - (Pocket Pond prospect (24)); Noranda Pocket Pond prospect (25); (McTavish prospect (26)); (Nickel Lake prospect (28)); (Brunette prospect (31)); Stanol prospect (32); (Rocky Islet Bay prospect (33)); (Ottotail Lake prospect (35)); (Young-Corrigan prospect (36)); Shoal Lake iron occurrence (52); Moose Point occurrence (75); Rice Bay occurrences (79); Cooper-Weiss occurrence (80); Wallace occurrence (81); Kotnick occurrence (83); Reef Point occurrence (84); Croome occurrence (85); Miller's Bay occurrence (86); Parry Strait occurrence (89).

Type 2: Mineralization Hosted by Layered Gabbro Intrusions

- A: Chalcopryite associated with gabbro and leucogabbro near the base of sills - North Rock Mine (5); (Stratmat-Copperlane prospect (16)); Hupchuk prospect (19); PCE prospect (21); (Belacoma prospect (22)); Redgut Bay prospect (23); (Daley-Galbraith prospect (29)); Stang prospect (42); Island Bay copper occurrences (63); Amalgamated Rare Earths occurrence (65); Drawbridge occurrences (77).
- B: Disseminated chalcopryite associated with siliceous phases of intrusions - Mironsky prospect (18); (Traverse Inlet prospect (20)); (Drawbridge occurrences (77)).
- C: Ilmenite-magnetite-apatite-rutile lenses in the upper portions of the intrusions - (Mironsky prospect (18)); Traverse Inlet prospect (20); Seine Bay iron prospects (41); Bear Pass iron occurrence (76).

Type 3: Vein Mineralization

- A: Quartz-gold-sulphide veins in shear zones and cleavage-parallel dilatant zones - Golden Star Mine (1); Foley Mine (2); Olive Mine (3); Pacitto prospect (6); Isabella Mine (7); Ferguson Mine (8); Golden Crescent Mine (9); Russell C. Cone Mine (10); Cone prospect (11); Stacey prospect (12); Alice "A" Mine (13); Turtle Tank prospect (14); Saundary Mine (15); (Stratmat-Copperlane prospect (16)); Young-Corrigan prospect (36); (Gagne Lake prospect (37)); Stellar Mine (43); South Vermilion Mine (44); McKenzie-Gray prospect (45); Dinosaurs prospect (46); Lucky Coon Mine (47); Manhattan-Decca mines (48); Blondeau-Merryth prospect (49); Emma Abbot occurrence (53); Gold Bug occurrence (54); East Turtle River occurrence (55); West Turtle River occurrence (56); Turtle Siding occurrence (57); McMillan occurrence (58); Emperor Mine (60); Gibson occurrence (61); Smylie occurrence (62); Stone occurrence (64); Corrigan occurrence (66); Thompson occurrence (68); Barber Lake gold occurrence (71); Scott Island occurrence (72); Swell Bay occurrence (73).
- B: Quartz-molybdenite-pyrite veins and disseminations in unmetamorphosed granitoid rocks - Bear Pass prospect (34); (Ottotail Lake prospect (35)); Tunnel Bay occurrence (74); Highway 11 molybdenum occurrence (78); Hopkins Bay occurrence (87); Otter Bay occurrence (88).

Type 4: Ultramafic-Hosted Mineralization

- Disseminated chalcopryite-pyrrhotite mineralization hosted by ultramafic metavolcanic rocks - (North Rock Mine (5)); Belacoma prospect (22).

Note: () parentheses around a property name are used to indicate that this type of mineralization is secondary to another type that also occurs on the same property.

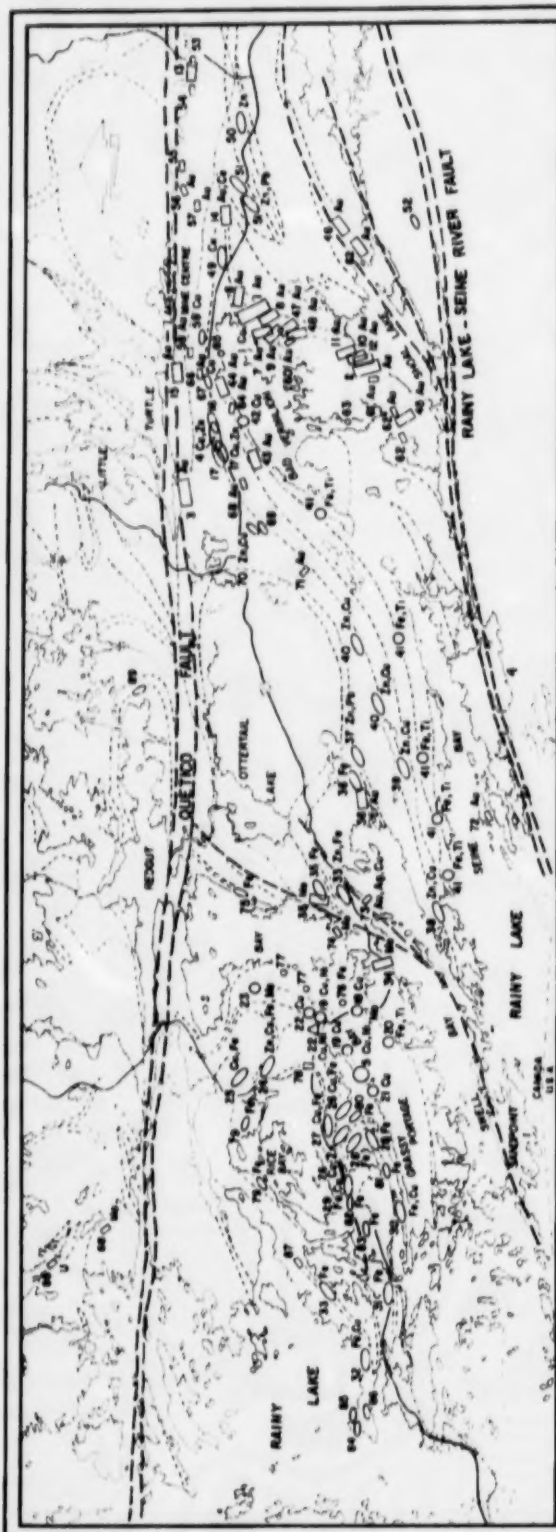
tion. The latter was mined in 1916 and, no milling facility being established in the immediate area, a few carloads of material grading approximately 3% copper were shipped to British Columbia.

The mineralized unit is succeeded abruptly to the north by a chert horizon approximately 1 m in width, which is in turn overlain by felsic quartz-eye tuffs, forming a thick hanging-wall sequence.

A total of 9 occurrences of the Wind Bay-Port Arthur Copper type of mineralization occupy a stratigraphic horizon that is exposed over a strike length exceeding 25 km. These are thought to represent the culmination of a poorly focused discharge of metals over a large area. Although these deposits collectively represent a substantial accumulation of base metals, no single prospect has yet been

shown to have sufficient metal content or tonnage to be economically viable.

Mineralization of Type 1C likewise represents a substantial dispersion of metal with a resulting low grade. At Pocket Pond, significant quantities of sphalerite and chalcopryite are associated with iron formation, which is composed dominantly of chert-magnetite and sulphide-bearing carbonates. The base metal mineralization is hosted by a unit of pyritic black shale and siltstone that is immediately beneath the iron formation. A single drill intersection through this mineralization yielded assays averaging 1.73% Zn and 0.09% Cu over a true width of 10 m (G. Armstrong, Prospector, personal communication, 1980). Chip sampling across a similar zone by Noranda Mines Limited at the McTavish prospect, Nickel Lake, yielded



INDEX OF PROPERTIES

I Properties with moderate production (>40,000 oz. Au.)

1 Golden Star Mine
2 Faley Mine
3 Olive Mine
4 Port Arthur Copper Co. Mine
5 North Rock Mine

II Properties with limited production (<40,000 oz. Au.) and/or extensive development

6 Pacific Prospect
7 Pacific Mine
8 Faley Mine
9 Golden Crescent Mine
10 Russell C. Cone Mine
11 Cone Prospect
12 Slope Prospect
13 Alice "A" Mine
14 Turtle Tank Prospect
15 Sandury Mine
16 Strama-Copacane Prospect
17 Ronda-Satellite Prospect
18 Prosperity Prospect
19 Huron Prospect
20 Tremaine Prospect
21 PCE Prospect
22 Beacom Prospect
23 Redgill Bay Prospect
24 Pocket Pond Prospect
25 Noranda Pocket Pond Prospect
26 McIntosh Prospect
27 Paraneque Prospect
28 Nickel Lake Prospect
29 Silver Lake Prospect
30 Silver Star Prospect
31 Bonnette Prospect

III Properties with limited production (<1,000 oz. Au.) and/or moderate development

32 Stord Prospect
33 Rocky Hill Prospect
34 Bear River Prospect
35 Ottertail Lake Prospect
36 Young-Corpen Prospect
37 Goppe Lake Prospect
38 Wind Bay Prospect
39 Lachart Lake Prospect
40 Fernington Boundary Prospect
41 Seine Bay Iron Prospects
42 Stang Prospect
43 Steller Mine
44 South Vermilion Mine
45 McKenzie Gray Prospect
46 Dickinson Prospect
47 Lundy Prospect
48 Manitowish-Decca Mines
49 Bonanza-Merrith Prospect
50 Novna Prospect
51 Poppon Prospect

IV Properties with limited production (<1000 oz. Au.) and/or limited development

52 Steel Lake Iron Occurrence
53 Evans Abbot Occurrence
54 Bag Occurrence
55 East Lake Occurrence
56 West Lake Occurrence
57 Turtle Siding Occurrence
58 McMillan Occurrence
59 Hickman Occurrence
60 Englewood Mine
61 Gibson Occurrence
62 Smylie Occurrence
63 Island Bay Copper Occurrence
64 Stone Occurrence
65 Unidentified Rare Earths Occurrence
66 Unidentified Copper Occurrence
67 Methers Occurrence

68 Thompson Occurrence
69 Kennedy 44A Occurrence
70 Bear River Occurrence
71 Steel Lake Gold Occurrence
72 Scott Island Occurrence
73 Swell Bay Occurrence
74 Tunnel Bay Occurrence
75 Moose Pond Occurrence
76 Bear Pass Iron Occurrence
77 Drawbridge Occurrence
78 Highway 11 Molybdenum Occurrence
79 Rice Bay Occurrence
80 Casper Weiss Occurrence
81 Wallace Occurrence
82 Moosehorn Occurrence
83 Red Point Occurrence
84 Crane Occurrence
85 Miller's Bay Occurrence
86 Hopland Bay Occurrence
87 Otter Bay Occurrence
88 Perry Strait Occurrence

SIZE CLASSIFICATION

SIZE CATEGORY	1A,B	1C,D	2A,B	2C	3A	3B	4
I							
II							
III							
IV							

MINERALIZATION TYPE

MINERALIZATION TYPE	1A,B	1C,D	2A,B	2C	3A	3B	4
I							
II							
III							
IV							



Figure 13. Summary map showing the distribution of mineral deposits in the Mine Centre-Fort Frances area. The symbols reflect the size, orientation and composition of known mineralized zones.

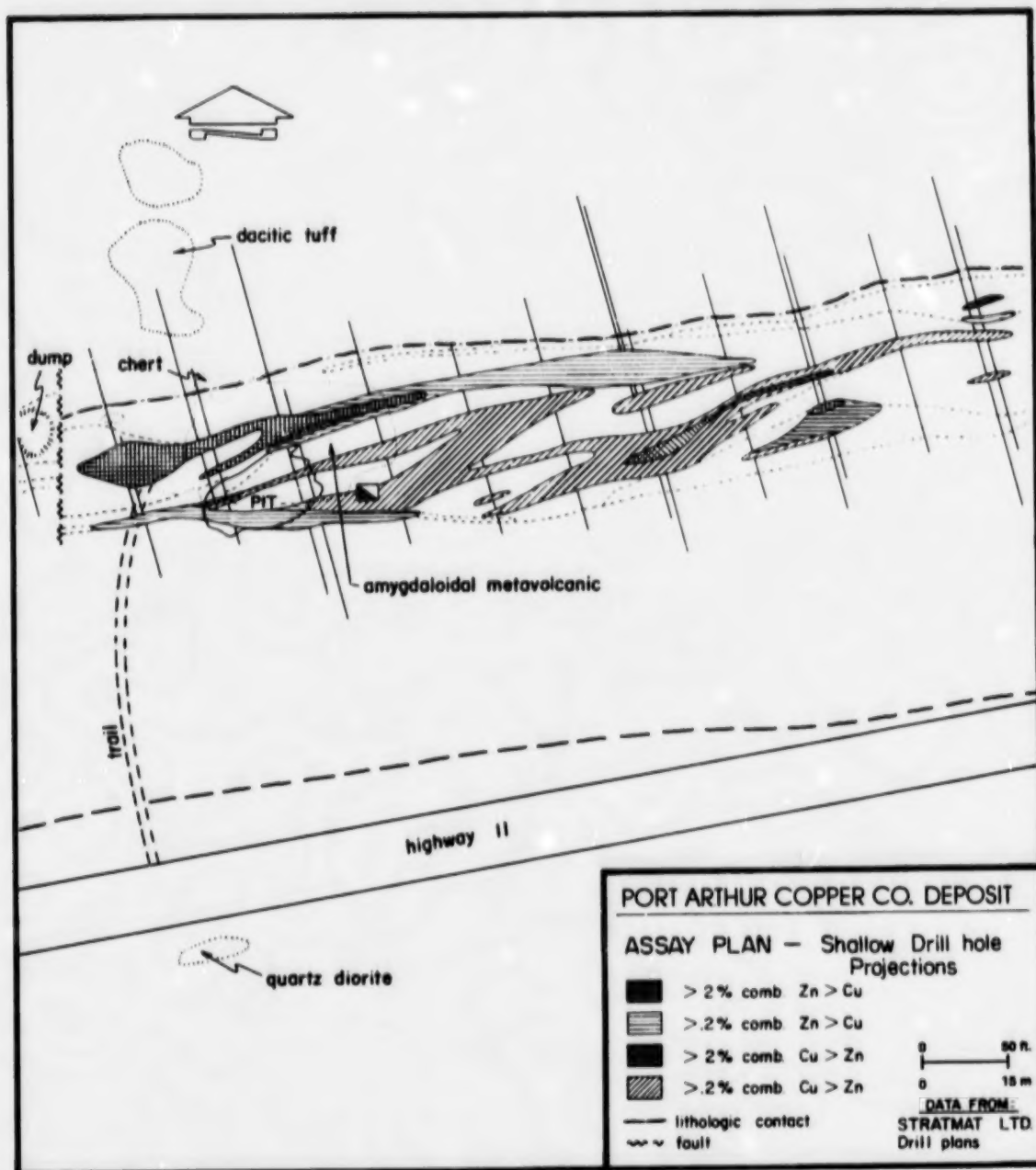


Figure 14. Relative distribution of zinc and copper in the Port Arthur Copper Co. deposit based on the surface projection of shallow diamond-drill holes. Data from the Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

average assays of 0.3% Zn and 0.1% Cu (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). A second type of mineralization more massive than this occurs at the main showing at Pocket Pond, where a small lens of massive pyrrhotite-sphalerite less than 0.5 m wide occurs in a laterally extensive lenticular zone of massive pyrrhotite-pyrite. The sulphide mineralization is overlain here stratigraphically by a 0.3 m layer of chert-magnetite.

The host rocks for all of the Type 1C mineralization are quite mafic and consist of basaltic flows and coarse-grained amphibolites that likely represent metadiabase sills. Ultramafic clastic rocks and turbidite-type metasedimentary rocks occur at higher stratigraphic levels.

Iron formation (Type 1D) is a common constituent of the predominantly mafic volcanic terrane in the western part of the study area at localities such as Nickel Lake and Reef Point. There is a common association of chert-magnetite beds immediately adjacent to a massive pyrite-pyrrhotite zone, which at some localities contains minor chalcopryrite. Total thicknesses of a few metres are rarely exceeded, and whereas the immediate host rock is commonly biotitic metasedimentary rocks, the iron formation is broadly associated with sections in which metabasalt is abundant.

TYPE 2: GABBRO-HOSTED MINERALIZATION

Mineralization occurs at 3 specific horizons in the gabbroic Grassy Portage and Seine Bay-Bad Vermilion intrusions. Basal segregations of chalcopryrite-pyrrhotite-pentlandite (Type 2A) form important occurrences along the northern margin of the south-facing Grassy Portage intrusion. The best example of this type occurs at the North Rock deposit, where 300 000 t of material grading 1.89% copper have been outlined. The mineralization is hosted by gabbro, melagabbro and leucogabbro near the base of the Grassy Portage intrusion where it is in contact with pillow lava and pillow breccia (unit 1, Map 2525). Mineralization consists of heavy disseminations of chalcopryrite and pyrrhotite with minor pentlandite and pyrite. Ilmenite, apatite and molybdenite are present locally. The sulphide minerals show textures that suggest a magmatic origin, whereas deuteric or metamorphic remobilization is evidenced by the presence of sulphide veins and local hydrothermal alteration. The deposit consists of 3 *en échelon* lenses, each approximately 50 m long and 10 m wide. Several other occurrences of similar type are exposed along strike from the deposit for 8 km to the northeast.

Near the top of the Grassy Portage intrusion, disseminated pyrrhotite-chalcopryrite mineralization is related to siliceous zones within the intrusion (Type 2B). Known as the Mironsky showing, this prospect was drilled by Phelps Dodge Corporation of Canada Limited in 1966 and again by Belacoma Mines Limited in 1978. Approximately 300 000 t of material grading 0.8% copper are present (Harris 1974). Although these zones may represent grano-

phyric differentiates, their sharp contacts and generally blocky nature suggest that they are assimilated blocks of country rock near the roof of the intrusion.

In the central to upper levels of both intrusions, substantial accumulations of iron-titanium mineralization (Type 2C) occur as lenticular zones of disseminated to massive magnetite and ilmenite with apatite and local rutile.

TYPE 3: VEIN MINERALIZATION

Quartz veins are common throughout the study area. Although most are unmineralized, 2 particular types host gold, and molybdenite mineralization, respectively. Gold-bearing veins (Type 3A) in the area have been developed and exploited intermittently since the 1890s. In most cases, the veins may be related to discrete shear zones and commonly occupy a central first-order fissure (Figure 15c). Second-order veins are foliation-normal and third-order veins are foliation-parallel.

The principal veins range in width from 10 cm to 2 m and are composed primarily of quartz with minor carbonate and local tourmaline. Visible gold and electrum were identified in a few veins and sulphide minerals, including pyrite, sphalerite, galena and chalcopryrite, are present in substantial quantities. Arsenopyrite and argentite are rare accessory minerals. Scheelite has been reported from gabbro-hosted quartz veins near Swell Bay (Harris 1974).

The gold content of veins is variable, but a study of available assay data suggests that grades as high as 15 ppm gold (0.5 ounce per ton gold) may be realistically sought over widths of approximately 1 m. This represents the approximate average grade of the 2 most successful past producers, the Olive and Golden Star mines (Beard and Garratt 1976).

The shear zones are systematically oriented and show senses of displacement consistent with a right-hand wrench zone (Figures 15a and 15b). The shear zones and their gold-bearing veins are found in most rock types in the area (Table 5), but there is a clear affinity for a coarse-grained felsic plutonic host of the tonalite-trondhjemite suite. Although shear zones are present throughout the study area, only those that occur in rocks metamorphosed to the greenschist facies contain gold-bearing vein systems (see Figure 15a). The above relationships suggest a late tectonic emplacement of the veins in rocks that readily formed dilatant zones at metamorphic grades suitable for precipitation of gold.

The molybdenite-bearing veins (Type 3B) in the Bear Passage-Rice Bay area show no evidence of shear zone development. These veins generally show sharp contacts with undeformed granodiorite or quartz monzonite, and are spatially associated with contacts with biotite schist. The best occurrence is located on Highway 11 at Bear Passage, where molybdenite and pyrite are abundant in extensional quartz veins in the Bear Pass pluton. The veins strike in northerly and westerly directions, and the best mineralization is located in veins near the pluton margins. A number of other quartz-pyrite-molybdenite occurrences are re-

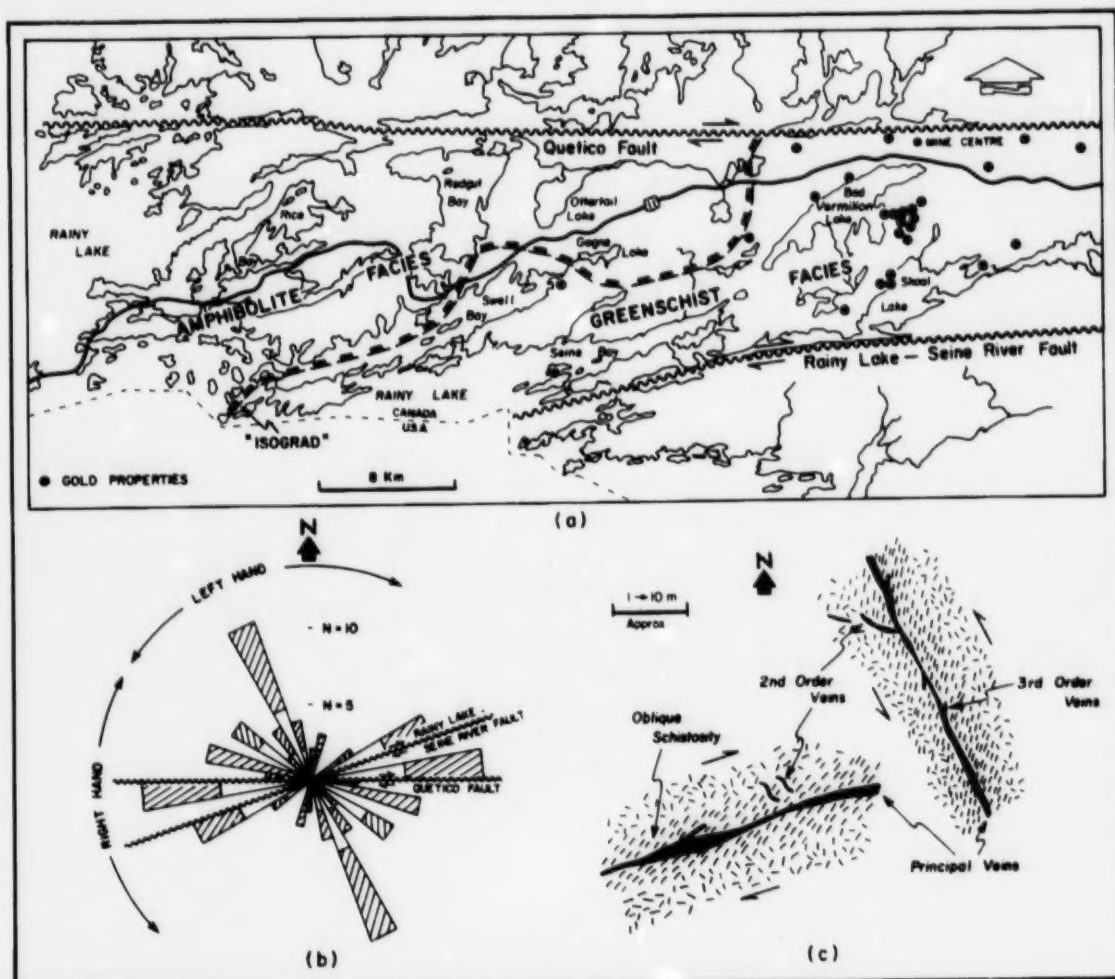


Figure 15. Controls on gold-bearing quartz veins in the Mine Centre-Fort Frances area. **a)** Distribution of mines, prospects and occurrences of gold relative to the metamorphic facies. **b)** The orientation of shear zones relative to the regional faults; sectors without diagonal lines represent shear zones with an indeterminate sense of displacement. **c)** Generalized morphology of the vein systems within shear zones.

Table 5. Lithologic controls on gold-bearing quartz veins, Mine Centre-Fort Frances area.

Host Rock Type	Number of Veins
tonalite, trondjemite	46
felsic and intermediate metavolcanics	16
metadiabase, amphibolite	9
metabasalt, chlorite schist	5
gabbro, anorthosite	4
conglomerate	1
quartz monzonite-granodiorite	0
Total Number of Veins	81
Total Number of Properties	26

lated to dikes and sills of granodiorite well removed from the main plutons. The majority of molybdenite occurrences are restricted to areas of amphibolite facies metamorphism.

TYPE 4: ULTRAMAFIC-HOSTED MINERALIZATION

The magnetic clastic ultramafic unit in the Rice Bay-Redgut Bay area hosts a number of showings of low-grade copper-nickel mineralization, referred to as the Belacoma prospect. Disseminated pyrrhotite with some chalcopyrite occurs as blebs and stringers in narrow zones of foliated ultramafic metavolcanic rocks. Reported grades are variable with best grab samples assaying as much as 0.29% Cu, 1.23% Ni and 0.17% Co, and best diamond-drill intersections assaying 0.45% Cu, 0.12% Ni over 0.55 m (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). Away from the mineralized areas, the ultramafic metavolcanic rocks contain approximately 1150 ppm Ni (average of 4 samples) indicating that metamorphic remobilization may have produced the low-grade sulphide zones.

Summary and Recommendations for Exploration

The foregoing descriptions emphasize the diversity of geological settings for mineralization in the Mine Centre-Fort Frances area. Volcano-sedimentary enrichments of base metals (Types 1C and 1D), which are in many respects analogous to Besshi-type massive sulphide deposits, occur in sequences dominated by mafic metavolcanic rocks (unit 1, Map 2525) and wackes (unit 5, Map 2525) in the north-western part of the area. In contrast, base metal mineralization associated with felsic metavolcanic rocks (Types 1A and 1B) show many similarities to Noranda- or Kuroko-type deposits (Sangster 1972). Base metal and oxide mineralization (Type 2) occurs in differentiated mafic sills which are probably subvolcanic. Gold and molybdenite in quartz veins (Type 3) reflect a late stage of mineralization associated with metamorphism, deformation and felsic plutonism. Finally, low-grade copper-nickel mineralization occurs in ultramafic metavolcanic rocks (Type 4).

Three types of mineralization warrant consideration as targets for future exploration:

1. The panel of felsic, intermediate and mafic metavolcanic rocks bounded to the north by Swell Bay, to the south by Seine Bay and Bad Vermilion Lake, and extending northwestward from Sandpoint Island to Mine Centre, contains a sequence in which volcanogenic mineralizing processes have clearly operated. The well-defined stratigraphic controls, footwall alteration, and a probable subvolcanic sill complex compare favourably with the setting of all known massive sulphide deposits in the Superior Province. The traces of tin associated with the sulphide mineralization at Gagne Lake are of particular interest. The geophysical expression of known sulphide mineralization in this area is quite variable due to relatively low iron sulphide contents; nonetheless, there are airborne electromagnetic targets (Ontario Geological Survey 1980) in this area that have yet to be investigated. The presence of distinctive footwall alteration at a number of the known occurrences should prove a useful guide for exploration. While the distinctive dalmatianite at Gagne Lake is due, in part, to proximity of the Ottertail Lake intrusion, alteration away from this area will be recognized only by field morphology coupled with lithogeochemical study. Distinctive chloritic alteration noted by the author in felsic rocks 3 km west-southwest of the Port Arthur Copper Co. deposit is an example of the latter type (see the description of the Thompson occurrence, property 68).
2. The bulk of known gold mineralization was discovered in this area by conventional prospecting methods in the 1890s. To the best of the author's knowledge, no grass-roots exploration program has been undertaken to locate potential gold mineralization in drift-covered terrain. The direct correlation of known occurrences with shear zones suggests that, as such, topographically recessive areas may prove attractive for further study. Structures such as the Quetico Fault, Rainy Lake-Seine River fault and shear zones along the northwestern shore of Bad Vermilion Lake and on the eastern side of Shoal Lake are possible examples. Large and persistent structures should be sought, as the historical difficulty of successful mineral exploitation at Mine Centre has been the failure to define vein networks that are sufficiently continuous and/or closely spaced to permit profitable mining in spite of locally suitable grades. Geophysical methods (VLF, IP) may be of value in locating shear zones. The structural observations reported herein suggest that shear zones that strike approximately east or northwest are the most suitable targets.
3. The northern margin of the Grassy Portage intrusion is known to be the base of a layered gabbroic intrusion, which locally contains substantial concentrations of chalcopyrite. These have been tested by shallow diamond-drill programs but the potential for further mineralization exists at depth along this well-defined contact. The base of the sill is truncated by a fault approximately 1 km west of the North Rock deposit, and lenses of sulphide mineralization are likely elongate in the direction of the moderate southwesterly regional plunge. These are 2 important structural considerations to guide future diamond-drill programs.

Deposit Descriptions

The following pages contain short descriptions of each of the 89 properties listed in Table 4. The descriptions are keyed to Map 2525, which shows the approximate boundaries for each property. In some cases, overlapping boundaries have resulted from successive exploration programs on essentially the same mineralized zone: in these instances, property boundaries have been subjectively placed on Map 2525 to correspond to the simplest possible configuration for purposes of description. Readers are therefore advised to check on the current status of each property for a precise definition of property boundaries.

Additional maps that cover the study area also provide useful background information concerning the geological setting of individual properties. Ontario Geological Survey Map 2443 (Blackburn 1977) shows the regional geology at a scale of 1 inch to 4 miles (1:253 440). Geological Survey of Canada Map 98A (Lawson 1913) at 1 inch to 1 mile scale (1:63 360) covers the entire area, and Geological Survey of Canada Map 334A (Tanton 1936) at 1 inch to 1/2 mile scale (1:31 680) emphasizes the setting of gold mineralization in the Mine Centre area. Other Ontario Geological Survey maps by Harris (1974, Maps 2278 and 2279) and by Wood et al. (1980a, 1980b, Maps P.2201 and P.2202) contain valuable detailed information on individual properties.

Use of the terms "Mine", "Prospect", "Occurrence" and "Deposit" in property names is historical and does not indicate compliance with mineral deposit category definitions.

The list of "Selected References" included with each property description below contains only the author's name(s), year of publication and a page reference, if applicable. For complete reference information, please refer to the "References" section at the end of this report.

1. GOLDEN STAR MINE (ORELIA GOLD MINES)

LOCATION: South of Mine Centre, west of Shoal Lake Road. Latitude 48°44.6'N, longitude 92°37'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Au, Ag, Cu

CLASSIFICATION: Types 3A, 1A

GENERAL GEOLOGY: The property is underlain by intercalated mafic, intermediate and felsic metavolcanic rocks (Figure 16). Quartz- and feldspar-phyric rocks are common. Mafic and felsic dikes locally cut the metavolcanic rocks, which are overlain unconformably to the east by conglomerates and arenites of the Seine metasediments. Pillow lavas on the Isabella property to the southwest indicate that the metavolcanic rocks face northward. Northwestern striking shear zones transect the volcanic sequence.

MINERALIZATION: Three subparallel northwesterly trending vein systems occur in shear zones within the metavolcanic rocks on this property. The near-vertical, lenticular, laminated quartz veins are approximately 1 m wide, and are composed mainly of quartz and ankerite with minor pyrrhotite, pyrite, chalcopyrite, sphalerite and galena. A rich ore shoot in the vicinity of the No.1 shaft (see Figure 16) reportedly contained abundant visible gold. Wall rocks adjacent to the veins are intensely foliated and are carbonate rich. Chalcopyrite and pyrrhotite stringers hosted by metavolcanic rocks are exposed in a pit 1000 feet (305 m) northwest of the No.1 shaft.

SIZE AND GRADE: A total production of 10 758 ounces of gold and 34 ounces of silver has been reported for the No.1 shaft area on the Star (Hunky) vein. An average grade of 0.56 ounce per ton gold over a 3.5-foot (1.1 m) vein width was reported. Estimates of reserves of 10 000 tons grading 0.45 ounce per ton gold are contained in reports circa 1939. No estimates of the extent of the volcanic-hosted copper mineralization are available. A small quantity of material was reportedly shipped in 1916.

HISTORY:

1894: Discovered by N. Berger and E. Randolph.

1898: No.1 shaft to 376 feet (115 m).

1899: No.1 shaft to 480 feet (146 m).

1900: Operations suspended.

1901: 1001 feet (305 m) of diamond drilling, No.2 shaft reopened; total production to 1901 reported at 8000 ounces of gold.

1916: Copper mineralization developed, small amount shipped by H. Woods.

1928: Optioned by Northern Red Lake Syndicate, five-stamp mills erected and open-cut mined at No.1 shaft; adjoining claims to the north explored by Scranton-Ontario Consolidated Mines Limited.

1934: Main shaft dewatered by Golden Star Consolidated Mines Limited.

1937-38: Orelia Gold Mines treated 200 tons of tailings from the shore of Bad Vermilion Lake.

1940: Commencement of mill installation by Lower Seine Gold Mining Company Limited.

1973: Magnetic and VLF electromagnetic surveys by Sybco Management Limited.

1974: 5 diamond-drill holes testing Star vein by FANEX Resources Limited (see Figure 16 for locations).

1981: Geological mapping by PIRP Investments Limited.

SELECTED REFERENCES:

Beard and Garratt 1976 (p.20)

Bow 1898 (p.73-74)

Bow 1899 (p.76-79)

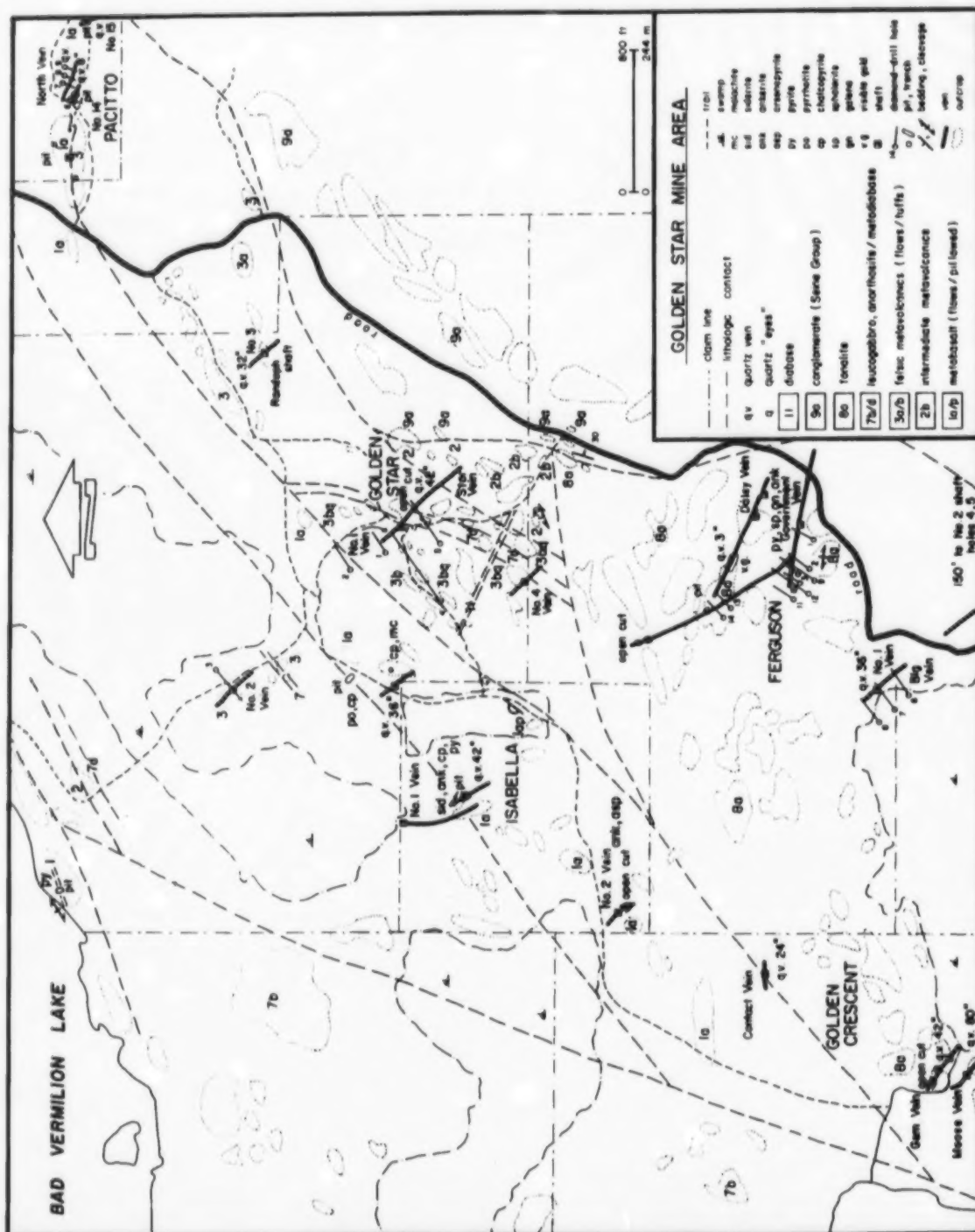


Figure 16. Geology of the Golden Star Mine area (geology by K.H. Poulsen in 1981).

- Bow 1900 (p.66-69)
- Bow and Carter 1901 (p.79-80)
- Bruce 1925 (p.27-28)
- Carter 1902 (p.242-243)
- Coleman 1898 (p.129)
- Ferguson, Groen and Haynes 1971 (p.255-256)
- Hawley 1930a (p.53-54)
- Hopkins 1922 (p.44-46)
- Parsons 1918 (p.174-175)
- Sinclair 1940 (p.213-214)
- Sutherland 1929 (p.134)
- Tanton 1935 (p.7-9)
- Tower 1942 (p.77)
- Tremblay 1941 (p.23)

2. FOLEY MINE (SANTA FE GOLD MINE)

LOCATION: South of Highway 11, west of Shoal Lake Road. Latitude 48°41.7'N, longitude 92°39'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Au, Ag

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by tonalite, which is unconformably overlain by Seine conglomerate to the southeast (Figure 17). Northerly to north-westerly striking shear zones contain altered, commonly foliated tonalite. Lamprophyre intrudes the conglomerate in the southern part of the property (not shown on Figure 17).

MINERALIZATION: Laminated quartz veins in the shear zones contain minor ankerite and tourmaline, with locally appreciable quantities of pyrite, chalcopyrite, arsenopyrite, galena and sphalerite. Visible gold was noted in the Lucky Joe vein and in the Bonanza vein.

SIZE AND GRADE: The property contains at least 9 distinct veins which have been developed to varying degrees.

The North Foley Sulphide vein strikes 340° and dips 80° northeast. It is up to 3.5 feet (1.1 m) wide and a chip channel sample across 39 inches (99 cm) yielded 0.10 ounce per ton gold (this study). Five diamond-drill intersections in the vicinity of this vein (see Figure 17) averaged 0.05 ounce per ton gold over widths averaging 2 feet (0.6 m).

The "A" vein strikes approximately due north and is vertical. Its average width is 16 inches (41 cm) and a chip channel sample (this study) over that interval yielded 0.02 ounce per ton gold. A diamond-drill intersection near the shaft yielded 0.08 ounce per ton gold over 4.4 feet (1.3 m) of core.

The Bonanza vein is the site of the North shaft. The vein is reportedly lenticular and 2 short drill intersections near the shaft (hole 7) yielded 0.28 ounce per ton gold over 0.3 feet (9 cm) and 0.20 ounce per ton gold over 0.2 feet (6 cm).

The Bonanza vein is a branch of the Jumbo vein. It too is lenticular, but maintains substantial widths along its exposed length. A chip channel sample across 4 feet, 11 inches (1.5 m) yielded 0.01 ounce per ton gold (this study).

The Goldpanner or West vein strikes 335° and is vertical. It averages 14 inches (36 cm) in width and a chip channel sample across this interval yielded 0.03 ounce per ton gold.

The South Foley Sulphide vein ranges up to 51 inches (130 cm) wide and strikes 335° with a vertical dip. Two chip channel samples yielded an average of 0.07 ounce per ton gold over 45 inches (114 cm).

The Lucky Joe vein, as exposed in a surface trench, is 12 inches (30 cm) wide. It strikes 350° and dips 75° northeast. A chip channel sample (this study) yielded 3.08 ounces of gold per ton and 0.12 ounce per ton silver while a diamond-drill intersection in the same area returned 0.01 ounce per ton gold over 0.6 feet (18 cm).

The South Foley or Daisy vein is a lenticular vein averaging 2.0 feet (0.6 m) wide. It strikes 340° and dips steeply northeast. Approximately 700 ounces of gold were produced from 800 tons of material from a near-surface open stope (R.C. Cone, Jr., Prospector, personal communication, 1980).

The Galena vein strikes 345° and dips 82° northeast. Its exposed width is 8 inches (20 cm), and a chip channel sample over that interval yielded 0.02 ounce per ton gold (this study).

Total production from the property has been estimated at 4300 ounces of gold from material grading 0.15 ounce per ton gold over widths of approximately 3 feet (0.9 m).

HISTORY:

1893: Discovered in September by T. Wiegand and A. Lockhart.

1894: Stripping of veins.

1895-97: Shafts sunk; produced 1695 ounces of gold by Foley Gold Mines.

1898: Shut down. North shaft to 420 feet (128 m); produced 310 ounces of gold.

1899-1900: Limited operation; total production to this date reached 3600 ounces.

1920-21: Dewatering and sampling by Swedish Canadian Mines Limited.

1922-27: Underground development, mainly in the area of the North shaft, on Bonanza vein by British Canadian Mines. North shaft to 850 feet (259 m).

1930-31: Building for 150-ton mill erected.

1933-34: Open stope to surface from South shaft. Gold treated in two-stamp mill by R.C. Cone, Sr.

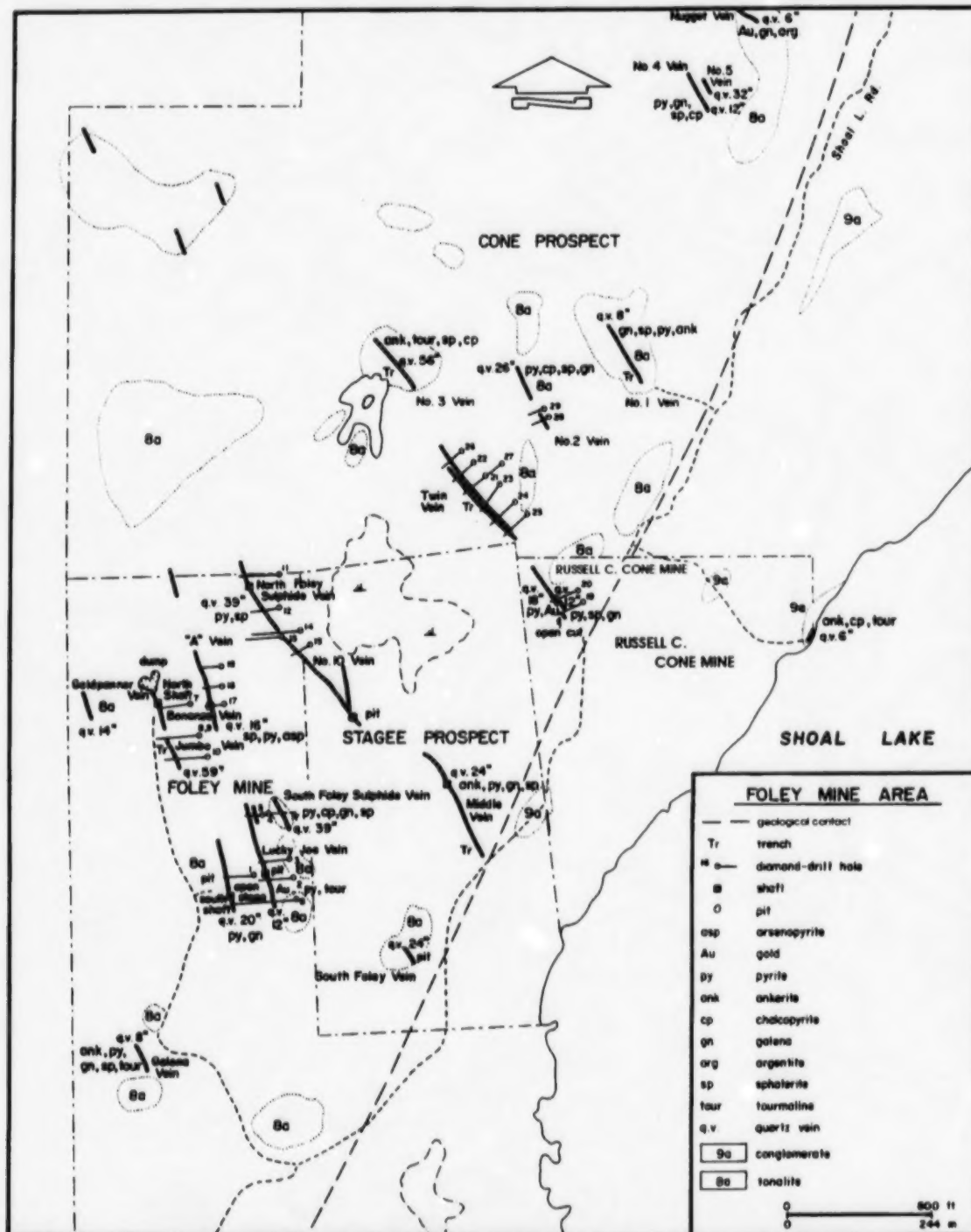


Figure 17. Geology of the Foley Mine area (geology by K.H. Poulsen in 1981). Other symbols as in Figure 16.

1935-40: Sampling by Santa Fe Gold Mines; small, high-grade ore shoots reported on 5th and 6th levels of Bonanza vein.

1979-80: Trenching by R.C. Cone, Jr.

1980: 18 diamond-drill holes (see Figure 17) by Corporate Oil and Gas Limited.

1982: Stripping, trenching and sampling by Sherritt Gordon Mines Limited.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.16)
- Blue 1897 (p.54-56)
- Bow 1898 (p.68-71)
- Bow 1899 (p.84)
- Bow 1900 (p.65-66)
- Bow and Carter 1901 (p.81-82)
- Bruce 1925 (p.25-27)
- Carter 1902 (p.243)
- Coleman 1895 (p.55-57)
- Ferguson, Groen and Haynes 1971 (p.253-254)
- Hawley 1930a (p.57-58)
- Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.
- Rogers and Young 1935
- Slaght 1897 (p.260-262)
- Sutherland 1926 (p.75)
- Tanton 1935 (p.11)

3. OLIVE MINE (PRESTON, GOLDOREL)

LOCATION: North of Canadian National Railway tracks near Little Turtle Lake. Latitude 48°46.2'N, longitude 92°43.3'W.

Map reference: NTS 52 C/15SE

COMMODITIES: Au, Ag

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: Laminated felsic tuffs are intercalated with medium-grained amphibolites, which are interpreted to be metadiabase sills. The felsic rocks possess a penetrative steep cleavage, which is oriented subparallel to primary layering and strikes 265° (Figure 18).

MINERALIZATION: A long, lenticular, quartz-carbonate vein occurs in a dilatant zone parallel to cleavage. Pyrite and visible gold occur in finely laminated grey quartz. Irregular quartz veins occur within shear zones in the metadiabase.

SIZE AND GRADE: The vein has been traced on surface for a length of 1000 feet (305 m) and ranges from 4 to 12 inches (10 to 30 cm) wide. Total production from under-

ground stopes is reported at 3572 ounces of gold and 343 ounces of silver from 7255 tons.

HISTORY:

1896-1900: Prospecting and development. "A" shaft to 245 feet (75 m), "B" shaft to 65 feet (20 m); early production period. Production of 2699 ounces.

1935-1941: Rehabilitation of workings, mill construction by Olive Gold Mines Limited, limited milling (50 ounces of gold).

1941: Mining of 2169 tons above the 135-foot (41 m) level by Goldorel Mining Company Limited (823 ounces of gold).

1963-64: Diamond drilling by Proteus Minerals Limited.

1979-80: 3 diamond-drill holes by Sherritt Gordon Mines Limited.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.31)
- Bow 1899 (p.46 and p.79-80)
- Bow 1900 (p.72-74)
- Bow and Carter 1901 (p.80-81)
- Bruce 1925 (p.28-30)
- Coleman 1897 (p.82)
- Coleman 1898 (p.128)
- Ferguson, Groen and Haynes 1971 (p.259)
- Hopkins 1922 (p.47)
- Sinclair 1937 (p.145-146)
- Sinclair 1939 (p.182)
- Tower 1946 (p.108)

4. PORT ARTHUR COPPER CO. MINE

LOCATION: On Highway 11, northwest of Bad Vermilion Lake. Latitude 48°45.5'N, longitude 92°41.3'W.

Map reference: NTS 52 C/15SE

COMMODITIES: Zn, Cu

CLASSIFICATION: Type 1B

GENERAL GEOLOGY: The property is underlain by mafic, intermediate and felsic metavolcanic rocks (Figure 19). No younging direction indicators are present but a similar sequence along strike to the southwest faces northward. Chloritic tuffs of intermediate composition are overlain by mafic flows and breccias. The latter are commonly amygdaloidal and are capped by a narrow cherty unit. They are overlain by, and in sharp contact with, a relatively homogeneous but locally ankerite-rich felsic tuff to the north. Two metadiabase sills cut the volcanic succession. The chloritic metavolcanic rocks are intensely foliated with a steep cleavage striking, on average, 260°, subparallel to rare bedding markers.

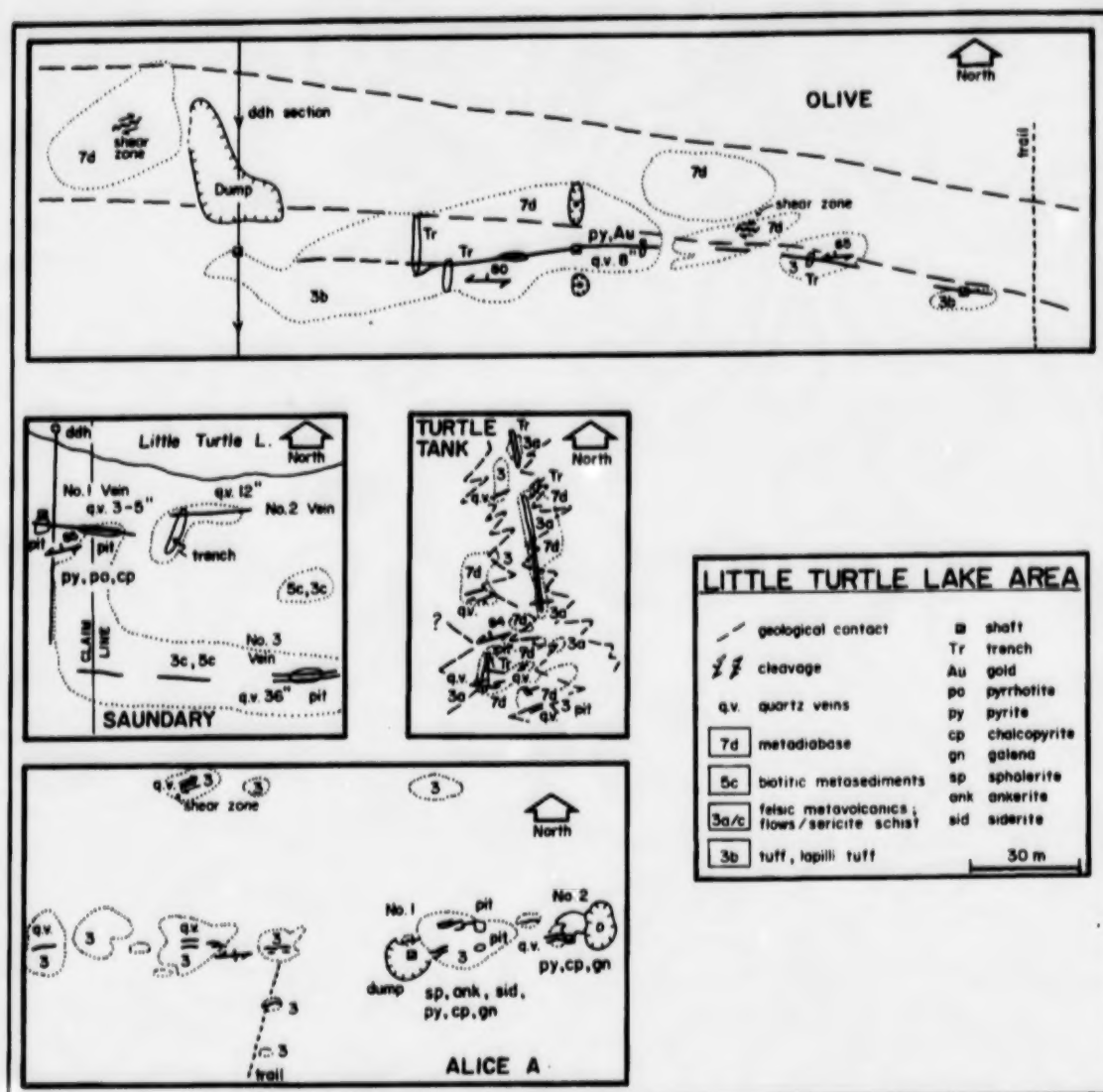


Figure 18. Geology of gold properties in the Little Turtle Lake area (geology by K.H. Poulsen in 1981). Other symbols as in Figure 16.

MINERALIZATION: Low-grade copper and zinc mineralization has been outlined by diamond drilling and surface development. The mineralization is stratabound and forms a 1000-foot-long (305 m) zone at the interface between the mafic volcanoclastic rocks and the overlying felsic tuffs. Seams and veinlets of sphalerite, chalcopyrite and pyrite occur in *en échelon* lenticular mineralized zones. These zones appear to follow fragmental horizons within the volcanic sequence, and are separated by non-mineralized amygdaloidal flows. The sulphide mineralization is crudely zoned into discrete chalcopyrite-rich (copper-rich) and sphalerite-rich (zinc-rich) areas. This inverse relationship between copper and zinc is reflected in Figure 14.

SIZE AND GRADE: The *en échelon* nature of the mineralized lenses is illustrated in Figure 14. Individual lenses range up to 10 m wide and consist of zinc-rich material grading up to 1.8% Zn, 0.9% Cu across a lens, copper-rich material grading 2.1% Cu across a lens, or low-grade material grading less than 1% Cu (assay plans, Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). A few carloads of copper mined from the open cut and shaft in 1917 reportedly averaged approximately 3% Cu. The best grades reported from diamond drilling are restricted to a 400-foot (122 m) strike length in the vicinity of this shaft.

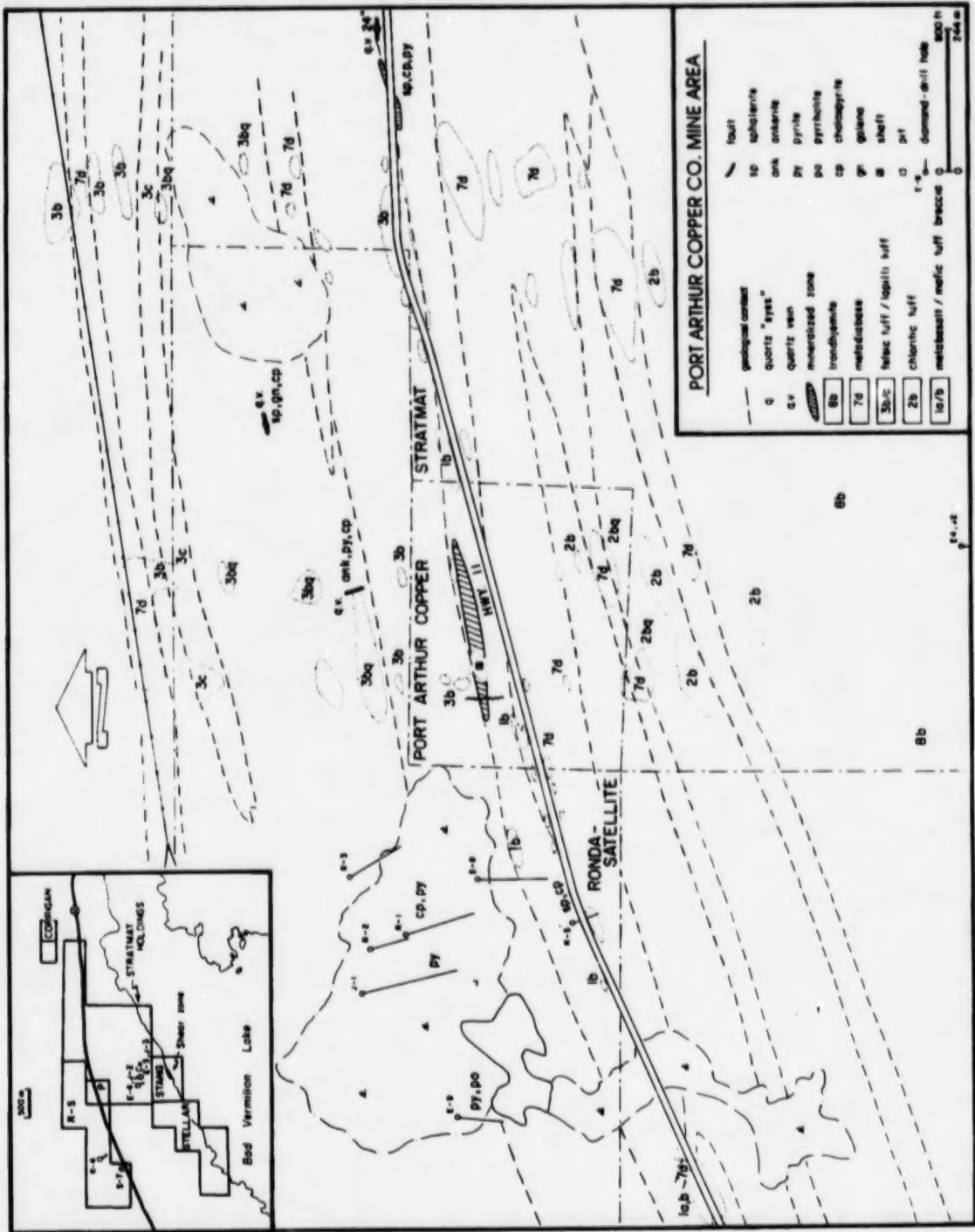


Figure 19. Geology of the Port Arthur Copper Co. Mine area (geology by K.H. Poulsen in 1980). Other symbols as in Figure 16.

HISTORY:

1916-17: Open cut and 100 foot (30 m) shaft with 200 foot (61 m) drift developed by Port Arthur Copper Company Limited; known as Hewitson and Johnson property. 26 509 pounds of copper produced.

1948: 5 diamond-drill holes by E. Corrigan.

1951: Limited diamond drilling by Noranda Mines Limited.

1955-56: Mapping, electromagnetic and magnetic surveys, and 35 diamond-drill holes by Stratmat Limited.

SELECTED REFERENCES:

Parsons 1918 (p.172-173)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Shklanka 1969 (p.224)

5. NORTH ROCK MINE (SOUTH GRASSY PROSPECT)

LOCATION: Near the southern shore of Grassy Portage Bay, straddling the Halkirk Township-Watten Township line. Latitude 48°43.0'N, longitude 93°02.6'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Cu, Ni, Mo

CLASSIFICATION: Types 2A, 4

GENERAL GEOLOGY: The property is underlain by mafic and ultramafic metavolcanic rocks, which are in contact with the Grassy Portage gabbroic intrusion (Figure 20). The ultramafic rocks are tuffs and lapilli tuffs that are generally actinolite-rich and intensely magnetic. Metabasaltic flows overlie these to the south, and pillow shapes indicate southward facing. The contact of the pillow lavas with the Grassy Portage intrusion is sharp, and is occupied by a 20 m thick unit of coarse-grained, hornblende-rich melagabbro. The melagabbro grades southeastward to medium- to coarse-grained gabbro composed of subequal proportions of hornblende and plagioclase. Layers of anorthosite composed of andesine intrude the gabbro at the southern margin of the property, where they are spatially related to masses of magnetite-actinolite amphibolite. Numerous mafic to intermediate dikes cut the gabbroic rocks.

MINERALIZATION: Chalcopyrite is concentrated at 3 specific localities near the base of the Grassy Portage intrusion.

1. The Main South zone was developed in 1959 and has been described by Hodgson (1959). Mineralization grading 1.5 to 4.5% Cu occurs as chalcopyrite-pyrrhotite in altered grey anorthosite, which occurs as bands up to several feet (about a metre) wide. Lower grades of copper occur in lenses of "spotted" gabbro that occur in normal equigranular gabbro. The "spots" were determined to be largely plagioclase megacrysts and glomeroporphyritic aggregates containing abundant

clinozoisite as an alteration product. Low grades of approximately 1% Cu and 1% Ni were encountered in coarse melagabbro at the base of the sill. Grey dikes containing fine disseminated sulphide minerals occur within the ore zones.

2. The Beaver Pond zone was developed by diamond drilling primarily in 1966-1967 and 1969-1970, and by the sinking of the North Rock shaft and completion of a drift (the East drive) in 1973. The "zone" consists of *en échelon* lenses ("A", "B" and "C") of chalcopyrite-pyrrhotite mineralization, which extend discontinuously for at least 300 m in an easterly direction. Both high-grade "grey" ores and lower-grade "black" ores are present. The grey ores are rich in chalcopyrite (3% Cu) and consist of bleached anorthosite, which is characterized by clinozoisite alteration with minor sericite and scapolite. Pale green apatite and equant centimetre-wide ilmenite grains are common associates. Biotite haloes commonly replace ilmenite grains and molybdenite is present locally. The black ores contain less chalcopyrite (less than 1% Cu, 0.1% Ni) and consist of equigranular to porphyritic gabbro with sulphide mineralization occurring as interstitial grains and fracture fillings. Molybdenite occurs locally, intergrown with the chalcopyrite and pyrrhotite or as discrete grains removed from other sulphides in grey patches of hydrothermal alteration within the gabbro.
3. At the East zone (or Line 33 showing), low-grade copper-molybdenum mineralization was outlined by diamond drilling in 1959 and 1966. The sulphide minerals consist of chalcopyrite, pyrrhotite and molybdenite, the latter of which occurs in association with "spotted" gabbro (Hodgson 1959).

SIZE AND GRADE: The Main South zone is at least 400 feet (122 m) long. The results from 7 diamond-drill holes (not shown on Figure 20) indicate lenticular mineralization with average grades less than 1% copper and widths ranging from 2 to 30 m.

The lenticular nature of the mineralization and the contrast in grades of the "grey" and "black" ore in the Beaver Pond zone result in a variety of tonnage/grade estimates for this deposit (Bergmann 1973). These range from 1 020 458 tons grading 1.17% copper over a strike length of 400 m, to 265 230 tons grading 2.08% copper over a strike length of 300 m. Average muck samples of approximately 3% copper were obtained from grey ores of the "A" and "C" zones during development of the East drive, thus verifying the diamond-drill results. All of the tonnage estimates to date are valid for a vertical depth of 300 feet (91 m) only, as the bulk of the drill data is from shallow holes.

The East zone has been tested by 2 diamond-drill holes. One intersection grades 0.425% Cu, 0.044% MoS₂ across 20 m of core. The same intersection, diluted to a greater width, yielded 0.223% Cu across 70 m of core. The vertical and lateral extent of this zone has not been tested.

HISTORY:

1958: Discovered by prospectors working for Noranda Mines Limited.

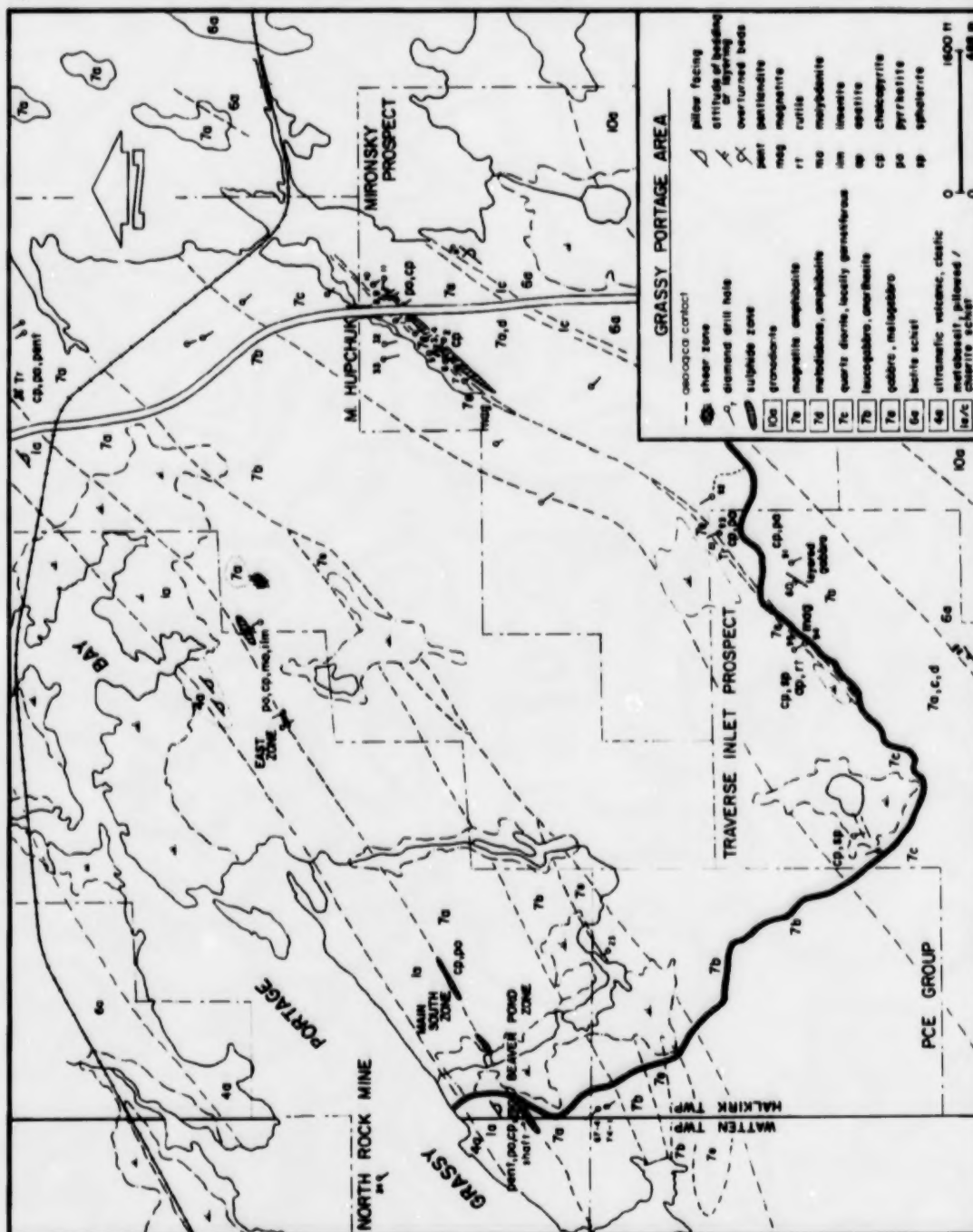


Figure 20. Geology of the Grassy Portage area (adapted from Hodgson (1959) and Harris (1974) with new mapping by K.H. Poulsen). Other symbols as in Figure 16.

1959-60: Trenching, geophysical and geological surveys, and 16 diamond-drill holes by Noranda Mines Limited.

1966-67: 31 diamond-drill holes by Noranda Mines Limited.

1969-70: 16 diamond-drill holes by Seemar Mines Limited.

1971-72: 17 diamond-drill holes by North Rock Explorations Limited.

1972-73: 200-foot (61 m) shaft and 700 feet (213 m) of drifting by North Rock Explorations Limited.

SELECTED REFERENCES:

- Bergmann 1973
- Harris 1974 (p.61-71)
- Hodgson 1959
- Shklanka 1969 (p.219)

6. PACITTO PROSPECT

LOCATION: South of Mine Centre, east of Shoal Lake Road. Latitude 48°44.9'N, longitude 92°36.4'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Au, Ag, Cu

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: Metavolcanic rocks comprising basalt and rhyolite are overlain unconformably to the south and east by metaconglomerate of the Seine metasediments (see Figure 16). Rare granitoid dikes and numerous shear zones cut the metavolcanic sequence.

MINERALIZATION: Numerous small quartz veins reportedly carry gold. Four of the larger veins are central to subvertical shear zones which strike westerly to northerly. They are hosted by foliated chlorite schist and are composed of quartz, ankerite, chlorite, pyrite and chalcopryrite. Azurite and malachite occur in the easternmost vein.

SIZE AND GRADE: The No.14 vein is 8 inches (20 cm) wide, strikes 290° and is hosted by a right-hand shear zone. A 1.5-foot (0.46 m) diamond-drill intersection yielded 0.15 ounce per ton gold, 0.7 ounce per ton silver, and 0.15% Cu.

The No.15 vein ranges up to 12 inches (30 cm) wide and strikes 350°.

The East vein (not shown on Figure 16) is located approximately 1200 feet (366 m) east-northeast of the No.15 vein, is 24 inches (61 cm) wide and strikes 240°.

The North vein consists of quartz stringers and vein quartz in a shear zone striking 290°. Diamond-drill intersections yielded 0.15 ounce per ton gold, 0.21% Cu over 2.5 feet (0.8 m) of core, and 0.03 ounce per ton gold, 0.30 ounce per ton silver over 2.6 feet (0.8 m) of core.

HISTORY:

Pre-1935: Pits and shallow shaft.

1974: 4 diamond-drill holes totalling 706 feet (215 m) by FANEX Resources Limited (see Figure 16 for locations).

SELECTED REFERENCE:

Tanton 1935 (p.10)

7. ISABELLA MINE

LOCATION: South of Mine Centre off Shoal Lake Road. Latitude 48°44.5'N, longitude 92°37.4'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Au, Ag

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by metabasalt and metarhyolite (see Figure 16). Pillow lavas face northwestward. Northwesterly striking shear zones transect the property.

MINERALIZATION: Two quartz vein systems are hosted by the foliated metavolcanic rocks. The original No.1 vein is composed of quartz, ankerite and siderite with some chalcopryrite, minor pyrite and sphalerite. Galena was also reported. The veins are laminated by wall rock inclusions, and the host rock is intensely foliated and carbonate rich adjacent to the vein. The No.2 vein outcrops near the southwestern corner of the property. It is hosted by altered metabasalt and is composed of quartz, ankerite, pyrite and erythrite. Arsenopyrite and coarse gold have been reported from ore shoots within the vein.

SIZE AND GRADE: The No.1 system consists of bifurcating veins striking approximately 330° and 350° (see Figure 16). The vein material averages 36 to 48 inches (91 to 122 cm) in width, with a 12-inch-wide (30 cm) carbonate-rich horse of wall rock present in the main branch of the vein. Production of 15.39 ounces of gold and 1.55 ounces of silver from 2 tons of vein material was likely realized from a shallow open pit developed at the junction of the branching veins.

The No.2 vein is lenticular and varies in thickness from 12 to 40 inches (30 to 102 cm). The vein strikes 140° and dips 65° southwest. A small, rich ore shoot was removed from an open cut in 1928, a second from 20 feet (6 m) underground in 1930, and a third from the surface in 1934. No accurate record of this production is available.

HISTORY:

1899: Stripping, test pit, and shaft to 65 feet (20 m) on No.1 vein.

1920-21: High-grade mining of open pit on No.1 vein.

1928: Discovery and development of No.2 vein by Northern Red Lake Mines Limited.

1930: Removal of high-grade pocket from No.2 vein.

1934: Removal of high-grade pocket from No.2 vein.

1973: Magnetometer and VLF electromagnetic surveys by SYBCO.

SELECTED REFERENCES:

Beard and Garratt 1976 (p.22)

- Bow 1900 (p.68)
 Ferguson, Groen and Haynes 1971 (p.256)
 Hawley 1930a (p.53-55)
 Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.
 Rogers 1920 (p.5-6)
 Rogers 1922 (p.5-6)
 Sutherland 1929 (p.134)
 Tanton 1935 (p.9-10)

8. FERGUSON MINE (MOSHER PROPERTY, KELLY'S LOCATION)

LOCATION: South of Highway 11 on Shoal Lake Road. Latitude 48°44.2'N, longitude 92°37'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The central part of the property is underlain by coarse-grained tonalite, which intrudes mafic to felsic metavolcanic rocks at the northern boundary (see Figure 16). Both metavolcanics and tonalite are unconformably overlain by conglomerate of the Seine metasediments in the eastern part of the property. Bedding in the conglomerate strikes northward and dips 30° to the east. Steep northwesterly striking shear zones cut the tonalite, and a northeasterly striking cleavage is present in the meta-sedimentary rocks.

MINERALIZATION: Gold-bearing quartz veins are confined to 3 shear zone systems: the Daisy vein, the Government vein, and the Big (Finn) vein (see Figure 16). The foliated tonalite adjacent to the veins is commonly chloritic and sericitic. Vein materials consist of quartz, ankerite, pyrite, chalcopyrite, arsenopyrite, sphalerite, galena and visible gold.

SIZE AND GRADE: The Daisy vein is steeply dipping and strikes 290°. It varies from 1 to 12 inches (2.5 to 30 cm) in width. It reportedly contains an ore shoot 120 feet (37 m) long grading 0.32 ounce per ton gold over 1 foot (0.3 m) in the vicinity of the shafts. Two diamond-drill intersections at the western extremity yielded an average of 0.03 ounce per ton gold over 4 feet (1.2 m) of core.

The Government vein strikes 280° and near its western end branches northwestward at 330°. The average grade of all samples from the shaft was reported at 0.15 ounce per ton gold over 18 inches (46 cm). An ore shoot tested by a drift at the 60-foot (18 m) level extends eastward 65 feet (20 m) and westward for more than 100 feet (30 m) from the shaft. The average grade of 27 samples from this shoot was reportedly 0.46 ounce per ton gold over 18 inches (46 cm). A recent diamond-drill intersection

through this zone yielded 0.26 ounce per ton gold over 19 inches (48 cm) true width. Two drill intersections testing the westward extension of this zone encountered 0.05 ounce per ton gold over 1 foot (0.3 m) of core and 0.03 ounce per ton gold over 2.1 feet (0.6 m) of core. At the intersection of the Government vein with its northwestward branch, 14.7 feet (4.5 m) of core (approximately 10 feet (3 m) true width) yielded an average grade of 0.20 ounce per ton gold. Two diamond-drill holes testing the northwestern branch, approximately 600 feet (183 m) from the intersection with the Government vein, yielded average grades of 0.35 ounce per ton gold over 27 inches (69 cm) of core. In addition, a diamond-drill hole intersected a narrow vein system 50 feet (15 m) to the south of, and parallel to, the Government vein near the branching intersection.

The Big vein strikes 315° and is 36 inches (91 cm) wide near the No.1 shaft. A drift at the 55-foot (17 m) level indicated a 33-foot-long (10 m) ore shoot grading 0.16 ounce per ton gold over 36 inches (91 cm). Three diamond-drill holes in this area yielded only one vein intersection grading 0.03 ounce per ton gold over 28 inches (71 cm). Results from 2 diamond-drill holes testing the south-eastward extension of the vein in the vicinity of the No.2 shaft also proved negative. Milling of dump material from the Ferguson property in 1934 reportedly yielded 150 ounces of gold.

HISTORY:

1894: Veins discovered.

1896: Two 50-foot (15 m) shafts on Daisy vein; No.2 shaft on Big (Finn) vein to 70 feet (21 m).

1899: Reopened, dewatered and sampled. By that time, main shaft on Daisy vein to 146 feet (45 m), main shaft on Government vein to 107 feet (33 m), No.1 shaft on Big vein to 65 feet (20 m) and No.2 shaft on Big vein to 110 feet (34 m).

1934: Dump material milled by Golden Star Consolidated Mines; approximately 150 ounces of gold recovered.

1940: Mapping and surface sampling by Sylvanite Gold Mines Limited.

1980: 14 diamond-drill holes testing Big vein, Government vein and Daisy vein by Corporate Oil and Gas Limited.

SELECTED REFERENCES:

Beard and Garratt 1976 (p.16)

Bow 1900 (p.72)

Coleman 1895 (p.57)

Coleman 1896 (p.65)

Coleman 1897 (p.80)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Tanton 1935 (p.7-8)

9. GOLDEN CRESCENT MINE (AD2 MINE, CAMPBELL PROPERTY)

LOCATION: South of Mine Centre, west of Shoal Lake Road. Latitude 48°44.2'N, longitude 92°37.7'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by mafic metavolcanic rocks, which are intruded by tonalite to the southeast. Anorthosite outcrops on the northwestern corner of the property (see Figure 16). Shear zones transect the property with a westerly to northwesterly strike.

MINERALIZATION: Three principal vertical vein systems have been developed on the property. They are parallel to the northwesterly striking shear zones and consist of laminated quartz veins cutting the tonalite and the metabasalt. Ankerite, pyrrhotite and pyrite are the accessory minerals, and horses and inclusions of host rock are common. The Gem vein (see Figure 16) makes a sharp contact with the equigranular tonalite.

SIZE AND GRADE: The Contact vein strikes east and averages 2 feet (0.6 m) in width. No assay data are available.

The Gem vein strikes 285° and averages 42 inches (107 cm) in width. Much of the 192 tons of ore milled in 1897 (see "History") came from this vein. Reported production was 77 ounces of gold yielding an average grade of approximately 0.40 ounce per ton gold.

The Moose vein strikes northwesterly and ranges up to 80 inches (203 cm) wide. No assay data are reported.

HISTORY:

1894: Discovered April 1894.

1897: Test pit on Contact vein, tunnel on Moose vein, tunnel and internal shaft on Gem vein. Production of 77 ounces of gold from 192 tons treated in two-stamp mill.

1899: Reopened after suspended operations. Contact vein test pit to 35 feet (11 m). Gem vein shaft to 112 feet (34 m) with drift at 88 feet (27 m). Moose vein tunnel extended to 153.5 feet (47 m).

1934: Rehabilitation of workings by Golden Crescent Syndicate.

SELECTED REFERENCES

- Beard and Garratt 1976 (p.19)
- Blue 1896 (p.157)
- Bow 1898 (p.74-75)
- Bow 1900 (p.71-72)
- Bow and Carter 1901 (p.82)
- Coleman 1898 (p.129)
- Ferguson, Groen and Haynes 1971 (p.254-255)
- Tanton 1935 (p.6-7)

10. RUSSELL C. CONE MINE (AL 94, MCLEAN PIT)

LOCATION: South of Highway 11 on Shoal Lake Road. Latitude 48°42.2'N, longitude 92°38.5'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain predominantly by conglomerate of the Seine metasediments, which overlies tonalite of the Bad Vermilion intrusion, exposed in the northwestern corner of the property (see Figure 17). The conglomerate possesses a pervasive north-easterly striking foliation, and a steep northwesterly striking shear zone cuts the tonalite.

MINERALIZATION: The most significant mineralization is hosted by quartz veins within the shear zone in the tonalite. Two veins are present: a pyrite-, sphalerite- and galena-bearing "sulphide" vein is separated from a parallel pyrite- and gold-bearing vein by a 24-inch (61 cm) horse of foliated tonalite. Foliation of the tonalite adjacent to the veins is common, and schistose tonalite extends up to 15 feet (4.6 m) away from the veins. Narrow sigmoidal quartz veins cut the foliation at a high angle. A 6-inch-wide (15 cm) quartz-ankerite-tourmaline-chalcopryrite vein occurs parallel with foliation in the Seine conglomerate along the shore of Shoal Lake. Low gold values have been reported (R.C. Cone, Jr., Prospector, personal communication, 1981).

SIZE AND GRADE: Gold was mined by R.C. Cone, Sr. from the northwestern corner of the property. Here the quartz vein averages 18 inches (46 cm) in width and strikes 340° with a dip of 70° to the northeast. Production of 1000 ounces of gold is reported from the open cut on this vein. The parallel sulphide vein averages 12 inches (30 cm) in width. A diamond-drill intersection approximately 100 feet (30 m) beneath the open cut returned 0.10 ounce per ton gold over 16 inches (41 cm) of core. A chip channel sample over 5 inches (13 cm) taken during the present study yielded 0.25 ounce per ton gold. A similar sample across 4 inches (10 cm) of a sigmoidal second-order vein yielded only a trace of gold.

HISTORY:

1916: Owned and developed by Colonel Ray, Port Arthur.

1949-59: High-grade gold mining by R.C. Cone, Sr.

1980: 2 diamond-drill holes totalling 400 feet (122 m) were drilled by Corporate Oil and Gas Limited.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.13)
- Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

11. CONE PROSPECT

LOCATION: South of Highway 11 on Shoal Lake Road. Latitude 48°42.4'N, longitude 92°38.4'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Au, Ag

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by tonalite with minor Seine conglomerate to the southeast (see Figure 17). Northwestern striking shear zones cut the tonalite and host laminated quartz veins. Slip lineations on vein walls are subhorizontal.

MINERALIZATION: The quartz veins contain some ankerite and tourmaline and generally abundant sulphide minerals including sphalerite, galena, chalcopyrite, pyrite and arsenopyrite. Argentite intergrown with electrum and galena was noted at one locality. Thin inclusions of foliated wall rock and variations in modal vein mineralogy result in pronounced lamination parallel to most of the veins. Reddish foliated wall rock contains abundant sericite, chlorite and carbonate.

SIZE AND GRADE: Seven vein systems are exposed on the southern part of the Cone property (see Figure 17). Two of these have been tested by diamond drilling, the remainder are exposed in trenches.

The Twin vein consists of 2 subparallel veins, each approximately 12 inches (30 cm) wide, separated by a horse of tonalite of variable width. Four diamond-drill hole intersections averaged 0.36 ounce per ton gold over 1.7 feet (0.5 m) of core for the easterly vein, and 0.03 ounce per ton gold over 3.2 feet (1.0 m) of core for the westerly vein. The veins strike 320° and dip 80° northeast.

The Nugget vein is 6 inches (15 cm) wide, strikes 305° and contains local occurrences of visible electrum with galena. No assay data are available.

The No.1 vein varies in width from 4 to 21 inches (10 to 53 cm), strikes 340° and dips 85° northeast. Two large blocks of vein material representing an average width of 8 inches (20 cm) yielded an average grade of 0.2 ounce per ton gold and 0.94 ounce per ton silver (this study).

The No.2 vein strikes 320° and dips 80° northeast. A chip channel sample (this study) from a trench at the northern end of the vein yielded 0.04 ounce per ton gold and trace silver over 26 inches (66 cm), and a single drill intersection from the southern end (hole 28) yielded 0.04 ounce per ton gold over 30 inches (76 cm) of core.

No assay data are available for the No.3 vein which, as exposed in a trench, is 56 inches (142 cm) wide and strikes 320°.

The No.4 vein is 12 inches (30 cm) wide and vertical, with a strike of 340°.

The No.5 vein strikes 170° and dips 50° southwest. It is up to 36 inches (91 cm) wide and visible gold has been reported.

HISTORY:

1890s: Part of "Weigand's Locations" (Bow 1898).

1915: Properties owned and developed by S.W. Ray.

1980: Trenching by R.C. Cone, Jr.; diamond drilling of 9 holes (see Figure 17) by Corporate Oil and Gas Limited.

1982: Option to Sherritt Gordon Mines Limited.

SELECTED REFERENCES:

Bow 1898 (p.75)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

12. STAGEE PROSPECT (HOPKINS)

LOCATION: South of Highway 11 on Shoal Lake Road. Latitude 48°42'N, longitude 92°38.7'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by coarse-grained tonalite, which is overlain by Seine conglomerate in the southeastern corner. Northwestern striking shear zones host several quartz veins.

MINERALIZATION: The laminated quartz veins contain moderate quantities of ankerite, sphalerite, galena, pyrite, chalcopyrite and tourmaline.

SIZE AND GRADE: Three principal vein sets occur on the property.

The No.10 vein is the southeastward extension of the North Foley Sulphide vein (see Foley Mine, property 2), strikes in a northerly direction and reportedly contains low gold values. The vein is approximately 40 inches (102 cm) wide.

The Middle vein strikes 335°, dips 75° northeast and ranges up to 36 inches (91 cm) wide. A chip channel sample across the vein near the shaft yielded 0.27 ounce per ton gold over 3 feet (0.9 m), and a large sample representing 24 inches (61 cm) of quartz gave a trace of gold in a pit at the southern end of the vein.

Short quartz veins in the southern part of the property range up to 16 inches (41 cm) wide and reportedly are gold bearing.

HISTORY:

1897: Sampled and trenched by Seine Manitou Gold Mining Company.

1915-17: Owned and developed by S.W. Ray.

1934: Shaft, 100 feet (31 m) deep, sunk on No.1 (Middle) vein by Wells Long Lac Company; 300 feet (91 m) of drifting.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.13)
Bruce 1925 (p.27)

13. ALICE "A" MINE

LOCATION: Two kilometres north of the intersection of the Bowes Camp Road and Highway 11. Latitude 48°46.2'N, longitude 92°28.2'W.

Map reference: NTS 52 C/16SW

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by foliated rhyolitic metavolcanic rocks (see Figure 18). The intense cleavage strikes 265°, is near vertical and is roughly parallel with the Quetico Fault, approximately 800 m to the north.

MINERALIZATION: Gold-bearing quartz veins and inch-wide (2.5 cm) stringers occur as *en échelon* arrays and are parallel to foliation in the metavolcanic rocks. Veins are commonly folded or possess a sigmoidal shape. Accessory minerals include ankerite, siderite, sphalerite, galena, chalcopyrite and pyrite.

SIZE AND GRADE: Stringer-rich schist forms discontinuous zones 24 to 36 inches (61 to 91 cm) wide. Few assay data are available but a 10-ton mill test in 1899 yielded 0.55 ounce per ton gold.

HISTORY:

1894-99: Owned by American Can Gold Mining Company; No.1 shaft to 95 feet (29 m), No.2 shaft to 70 feet (21 m); 150 to 200 tons treated by a two-stamp mill.

1974: Stripping and trenching by R. Pitkanen.

1976: Part of Hanna prospect (see property 50); geo-physical and geological surveys.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.7)
Bow 1898 (p.75)
Bow 1899 (p.81)
Bow 1900 (p.75)
Coleman 1898 (p.129-130)
De Kalb 1899 (p.46)

14. TURTLE TANK PROSPECT

LOCATION: East of Mine Centre, south of Canadian National Railway track. Latitude 48°45.5'N, longitude 92°33.5'W.

Map reference: NTS 52 C/15SE

COMMODITIES: Au, Cu, Ag

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by quartz-sericite schists of volcanic origin, which are intercalated with chloritic metadiabase. The strike of the lithologic contacts is approximately north but the development of an intense easterly striking cleavage that is axial planar to angular folds results in interdigitation of the two rock types (see Figure 18).

MINERALIZATION: Quartz veins and stringers locally parallel the intense foliation in both rock types. Veins are commonly folded and locally contain abundant ankerite, chalcopyrite, pyrrhotite and pyrite. Sphalerite has also been reported.

SIZE AND GRADE: The quartz veins are a few inches to a foot (about 10 to 30 cm) wide and are erratically distributed. An average grade for 5 samples of vein material has been reported as 0.005 ounce per ton gold, 0.24 ounce per ton silver, 1.22% copper, and 0.01% zinc.

HISTORY:

1917: Trenching and diamond drilling by L. Hedburg (Parsons 1918).

1970: Part of the Blondeau-Merryth prospect (see property 49); trenching.

1976: Linecutting, trenching and sampling by Ed-Vic Explorations.

SELECTED REFERENCES:

- Parsons 1918 (p.175)
Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.
Shklanka 1969 (p.225)

15. SAUNDARY MINE (HEADLIGHT, SWEDE BOY)

LOCATION: Northwest of Mine Centre on the southern shore of Little Turtle Lake. Latitude 48°46.4'N, longitude 92°39'W.

Map reference: NTS 52 C/15SE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by chloritic, biotitic and sericitic schists of sedimentary and volcanic origin (see Figure 18). A strong foliation is developed subparallel to the Quetico Fault immediately to the north of the deposit. This foliation prevents definite interpretation of the host rock types.

MINERALIZATION: Quartz veins ranging from 1 inch (2.5 cm) to 3 feet (0.9 m) in width occur as parallel lenses within the foliation. A metallurgical test of a 200-pound sample in 1936 revealed the presence of pyrite, pyrrhotite, marcasite, limonite, chalcopyrite, arsenopyrite, galena and gold.

SIZE AND GRADE: Quartz veins occupy 3 zones on the property.

The No.1 vein ranges up to 12 inches (30 cm) wide and dips steeply northward. Inch-wide (2.5 cm) stringers also parallel the vein in the adjacent schist. Twenty tons of ore mined from the pit on surface in 1929 reportedly averaged 0.85 ounce per ton gold. Fifteen tons mined from underground in 1935 graded 0.8 ounce per ton gold.

The No.2 vein is up to 12 inches (30 cm) wide and strikes 270°. Grades of 0.04 ounce per ton gold have been reported over this width.

The No.3 vein strikes 270° and ranges up to 36 inches (91 cm) wide. No assay data are available.

HISTORY:

1896-98: Swede Boy (Rode) Mine; shallow shaft.

1899: Headlight Mine; shaft to 105 feet (32 m); drifts and crosscuts at 75.5 feet (23 m).

1929: Twenty tons of ore processed at Copper Cliff yielded 17 ounces of gold.

1932-35: Saundary Mine; 15 tons of "selected" ore from underground yielded 13 ounces of gold; 50 feet (15 m) of underground drifting.

1940: Sampled by Sylvanite Gold Mines Limited.

1981: Diamond-drill hole (310 feet; 94.5 m) by R.C. Cone, Jr. and R. McMillan.

SELECTED REFERENCES:

Beard and Garratt 1976 (p.36)

Bow 1900 (p.74-75)

Coleman 1897 (p.82)

Ferguson, Groen and Haynes 1971 (p.259-260)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Sinclair 1935 (p.98)

Sinclair 1936 (p.139)

Tanton 1935 (p.4)

16. STRATMAT—COPPERLANE PROSPECT (see also PORT ARTHUR COPPER CO. MINE (4), RONDA—SATELLITE PROSPECT (17), STANG PROSPECT (42), STELLAR MINE (43) and CORRIGAN OCCURRENCE (66))

LOCATION: On Highway 11, northwest of Bad Vermilion Lake. Latitude 48°45.5'N, longitude 92°40.6'W.

Map reference: NTS 52 C/15SE

COMMODITIES: Cu, Zn

CLASSIFICATION: Types 1B, 2A, 3A

GENERAL GEOLOGY: The northern part of the property is underlain by a northward-facing succession of metavolcanic rocks ranging in composition from basalt to rhyolite (see Figure 19). Much of the sequence is composed of tuffs, lapilli tuffs and breccias, but some amygdaloidal mafic flows are present. Narrow sills of metadiabase cut the metavolcanic rocks, and the southern part of the property is underlain by wide sills of trondhjemite and coarse-grained gabbroic rocks that range to anorthosite in composition. A steep foliation subparallel to bedding commonly strikes 260°, and discrete shear zones cut the plutonic rocks. Greenschist facies metamorphic assemblages are typical.

MINERALIZATION: Stratmat Limited consolidated a number of properties in 1956 and mineralization associated with each of these is described elsewhere in this publication (see Figure 19, inset). Exclusive of these smaller subareas, mineralization was encountered in 3 distinct settings:

1. A narrow zone of sphalerite, pyrite and chalcopryrite mineralization occurs approximately 3000 feet (915 m) eastward along strike from the Port Arthur Copper Co. Mine (see Figure 19). The mineralization occurs in chloritic and ankeritic mafic fragmental rocks at a sharp contact with overlying felsic tuffs to the north.
2. Three sulphide-bearing quartz veins reportedly contain silver and gold.
3. Leucogabbro in the southern part of the property (Johnson claims; not shown) hosts minor chalcopryrite and pyrrhotite (see Figure 19, inset) as tested by 4 drill holes (J-3, J-2, E-4, E-5).

SIZE AND GRADE: No assay data are available for these mineralized zones. Diamond-drill logs and private company reports (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora) suggest that no significant values were encountered.

HISTORY:

1955-56: Geological mapping, electromagnetic and magnetic surveys, and 9 diamond-drill holes by Stratmat Limited.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

17. RONDA—SATELLITE PROSPECT

LOCATION: On Highway 11, northwest of Bad Vermilion Lake. Latitude 48°45.5'N, longitude 92°41.9'W.

Map reference: NTS 52 C/15SE

COMMODITIES: Cu, Zn, Pb, Ag

CLASSIFICATION: Type 1B

GENERAL GEOLOGY: The property is underlain by intercalated metavolcanic rocks (see Figure 19). Mafic and intermediate compositions give way northward to felsic

tuffs. The metavolcanic sequence is cut by quartz porphyry lenses and narrow sills of metadiabase. Steep foliation in the metavolcanics strikes 260°, subparallel to bedding markers.

MINERALIZATION: Narrow sulphide lenses containing sphalerite, chalcopyrite and galena in foliated mafic metavolcanic rocks were exposed during the construction of Highway 11. These showings are located 1500 feet (457 m) and 4600 feet (1402 m) (not shown on Figure 19) westward from the Port Arthur Copper Co. Mine, and although they are very small occurrences, both appear to be of similar type. Diamond-drill holes (E-9, J-1, R-1) and recent trenches to the north also intersected narrow pyritic zones that contain minor chalcopyrite. These zones are broadly coincident with the stratigraphic contact between amygdaloidal breccias and felsic tuffs (see Figure 19). Quartz-carbonate veins occur in shear zones and as extensional veins in quartz porphyry.

SIZE AND GRADE: Few assay data have been reported from the diamond-drill programs designed to test the above mineralization. Grab samples from the eastern roadside occurrence reportedly yielded 7.63% Zn, 2.89% Pb, 0.3% Cu and 1.39 ounces of silver per ton (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). A shallow drill hole (R-5) that tested this zone failed to yield any values, however.

HISTORY:

1955-56: Mapping, electromagnetic and magnetic surveys, and 2 diamond-drill holes (J-1, E-9) by Stratmat Limited.

1963: 3 diamond-drill holes totalling 1048 feet (319 m) by Satellite Metal Mines Limited (S-Series).

1966-67: Magnetic, electromagnetic and IP surveys; 2042 feet (622 m) of diamond drilling (R-Series) by Ronda Copper Mines Limited.

1980: Trenching and stripping by Ed-Vic Explorations.

SELECTED REFERENCES:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Shklanka 1969 (p.224)

18. MIRONSKY PROSPECT

LOCATION: On Highway 11 near Bear Passage. Latitude 48°42.1'N, longitude 93°01.7'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Types 2B, 2C

GENERAL GEOLOGY: The property is underlain by rocks of the upper zone of the Grassy Portage intrusion and by metasedimentary rocks at the southern contact of the intrusion (see Figure 20). Garnetiferous quartz diorite, magnetite-apatite amphibolite, quartz-plagioclase schist and

quartz gabbro form the dominant members of the Grassy Portage intrusion exposed on this property. Xenoliths of black amphibolite are thought to be assimilated mafic metavolcanic rocks. Actinolitic metavolcanic rocks occupy the contact between the intrusion and staurolite-bearing biotite schists to the south. Graded beds in the latter indicate southeastward facing of the sequences despite a northwestward dip of 45°.

MINERALIZATION: Disseminated chalcopyrite and pyrrhotite total less than 5% by volume of the quartz-plagioclase schist member. This siliceous schist occurs at the contact of the magnetite-apatite amphibolite and quartz gabbro to the south (see Figure 20), and is thought to represent a large block of assimilated metasedimentary schist that has been thoroughly recrystallized. The schist contains biotite, actinolite, chlorite, sphene and apatite as accessory minerals. The biotite and sphene are spatially related to the sulphide mineralization.

SIZE AND GRADE: The mineralized lens of sulphide-bearing schist has been outlined by diamond drilling for a strike length of 250 m and an average thickness of 10 m. Harris (1974) estimated 300 000 tons grading 0.8% copper to a depth of 100 m over a strike length of 130 m, based on the 1963 drill results. Recent drilling has confirmed the grade and extended the strike length of the zone. Diamond-drill hole B-3 (hole 3, see Figure 20) encountered 11 m of core grading 1.23% copper (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). As the zone dips 45° northwestward, this effectively represents a true width.

HISTORY:

1963: Discovered by M. Hupchuk and optioned to Phelps Dodge Corporation of Canada, Limited; 10 diamond-drill holes.

1975-76: 2 drill holes (32 and 33) by G. Armstrong.

1978: 11 diamond-drill holes by Belacoma Mines Limited.

1979: 1 diamond-drill hole (92) (see Figure 20) in the southwestern part of the property by G. Armstrong.

SELECTED REFERENCES:

Harris 1974 (p.58-59)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

19. HUPCHUK PROSPECT

LOCATION: Southwest of Redgut Bay. Latitude 48°42.5'N, longitude 93°02.0'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Cu, Ni

CLASSIFICATION: Type 2A

GENERAL GEOLOGY: The property is underlain dominantly by rocks of the lower zone of the Grassy Portage intrusion (see Figure 20). Southeastward-facing pillow lavas

along the northern margin of the intrusion are overlain successively by melagabbro, gabbro and leucogabbro. These members strike northeasterly and are thought to dip steeply to the northwest. The gabbroic rocks are composed of varying proportions of hornblende and labradorite. Biotite-garnet schists with disseminated sulphide minerals are common in shear zones.

MINERALIZATION: Copper-nickel mineralization occurs at two localities along the northern margin of the Grassy Portage intrusion. The southwestern occurrence consists of ilmenite, chalcopyrite and pyrrhotite as disseminations in gabbro. Mineralization exposed in a trench at the northeastern showing consists of pyrrhotite, chalcopyrite and pentlandite as grains interstitial to silicate minerals in melagabbro.

SIZE AND GRADE: Both mineralized zones have been tested by diamond drilling but no assay data have been reported. Harris (1974) reported assays of 0.2% Cu and 0.13% Ni for a representative sample from the length of the trench at the northeastern showing. This mineralization resembles the "black" ore at the North Rock deposit to the southwest.

HISTORY:

Early 1900s: Northeastern showing likely discovered and trenched.

1963: Part of property optioned to Phelps Dodge Corporation of Canada, Limited; geological mapping and 2 diamond-drill holes in southeastern part of property.

1966: Part of property optioned to Noranda Mines Limited; 2 holes drilled on southwestern showing.

1968: 4 diamond-drill holes by G. Armstrong and M. Hupchuk, 2 of which tested the eastward extension of the northeastern showing.

SELECTED REFERENCES:

Harris 1974 (p.50-53)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

20. TRAVERSE INLET PROSPECT (SWELL BAY PROPERTY)

LOCATION: North of Swell Bay near Traverse Inlet in Halkirk Township. Latitude 48°41.3'N, longitude 93°02.8'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Cu, Zn, Ti

CLASSIFICATION: Types 2C, 2B

GENERAL GEOLOGY: The property is underlain by a southward-facing sequence consisting, in succession, of leucogabbro, garnetiferous quartz diorite, magnetite-apatite amphibolite, quartz gabbro and metasedimentary biotite schist. With the exception of the leucogabbro, the members of the Grassy Portage intrusion (see Figure 20)

are fine to medium grained, and may include amphibolite xenoliths of mafic volcanic origin. The dip of the succession is moderate and to the northwest.

MINERALIZATION: Chalcopyrite, pyrrhotite and rare pyrite are found as disseminations in quartz diorite, magnetite amphibolite and quartz gabbro. Moderate concentrations of magnetite, up to 50% by volume, occupy local patches in the magnetite amphibolite. This rock contains abundant actinolite and magnesian chlorite and, locally, talc. Spatially associated with this unit are local siliceous pegmatoid masses of nelsonite, a rock rich in rutile. Sphalerite was noted in seams up to 10 cm wide in the quartz diorite. These likely are associated with assimilated metavolcanic xenoliths.

SIZE AND GRADE: Geophysical data and limited diamond drilling (see Figure 20) indicate that the magnetite-apatite amphibolite is a formational unit within the Grassy Portage intrusion. One sample of oxide-rich material yielded an analysis of 33.5% FeO (total iron) and 2.5% TiO₂. The rutile in the nelsonite is too erratic in distribution to be of value. A drill hole into disseminated sulphide mineralization west of a small lake gave a best assay of 2.53% Zn, 0.11% Cu over 3.3 m of core (Harris 1974).

HISTORY:

1959-60: Geological mapping by Noranda Mines Limited.

1965: Staked by M. Hupchuk.

1966: Option to Cominco Limited; geological mapping and induced polarization and magnetic surveys.

1968: Diamond drilling by M. Hupchuk and G. Armstrong (2 westerly holes, see Figure 20).

1978: Power stripping and 4 diamond-drill holes (91, 93, 94, 95) by G. Armstrong and M. Hupchuk.

SELECTED REFERENCES:

Harris 1974 (p.53)

Hodgson 1959

21. PCE PROSPECT

LOCATION: At the Halkirk-Watten township line, south of Grassy Portage Bay. Latitude 48°41.7'N, longitude 93°04.5'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Type 2A

GENERAL GEOLOGY: The property is underlain by rocks composing the lower zone of the Grassy Portage intrusion. Gabbro, leucogabbro and magnetite-actinolite amphibolite are the most common rock types. Minor anorthosite and mafic dikes cut the gabbroic rocks, which are thought to form a steep northerly dipping sequence (see Figure 20). Magnetic ultramafic clastic rocks and southward-facing pillow lavas are found to the north of the intrusion.

MINERALIZATION: Disseminated chalcopyrite has been reported with pyrrhotite in local patches within gabbroic rocks and in fractures in mafic metavolcanic rocks beneath Grassy Portage Bay. Magnetite is concentrated within the magnetite amphibolite unit of the Grassy Portage intrusion.

SIZE AND GRADE: The above mineralization has been tested by diamond drilling but no significant values or widths have been reported.

HISTORY:

1959-60: 60 claims optioned to Noranda Mines Limited by PCE Explorations Limited; geological, electromagnetic and magnetic surveys; 2 diamond-drill holes (23 and 24).

1967: 1 diamond-drill hole by Noranda Mines Limited (67-4).

1969: Trenching in gabbro by G. Laberge along Grassy Portage Bay.

SELECTED REFERENCES:

Harris 1974 (p.62)

Hodgson 1959

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

22. BELACOMA PROSPECT (NORTH 60)

LOCATION: On Highway 11, Halkirk Township. Latitude 48°43.1'N, longitude 93°02.1'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Ni, Cu

CLASSIFICATION: Types 4, 2A

GENERAL GEOLOGY: From northwest to southeast the property is underlain by 4 northeasterly striking mappable units: porphyroblastic biotite schist, magnetic clastic ultramafic rocks, pillowed and massive metabasalt, and gabbroic rocks. The pillowed basalts face southeastward (Figure 21) while graded beds in the porphyroblastic biotite schist suggest that this unit is overturned to the northwest: a discordance, possibly a fault, is indicated within and parallel to the ultramafic unit. The ultramafic rocks are composed of ash- to lapilli-sized fragments which, while generally fine grained, commonly show concentric zoning about a medium-grained amphibolitic core. The gabbroic rocks form part of the base of the Grassy Portage intrusion,

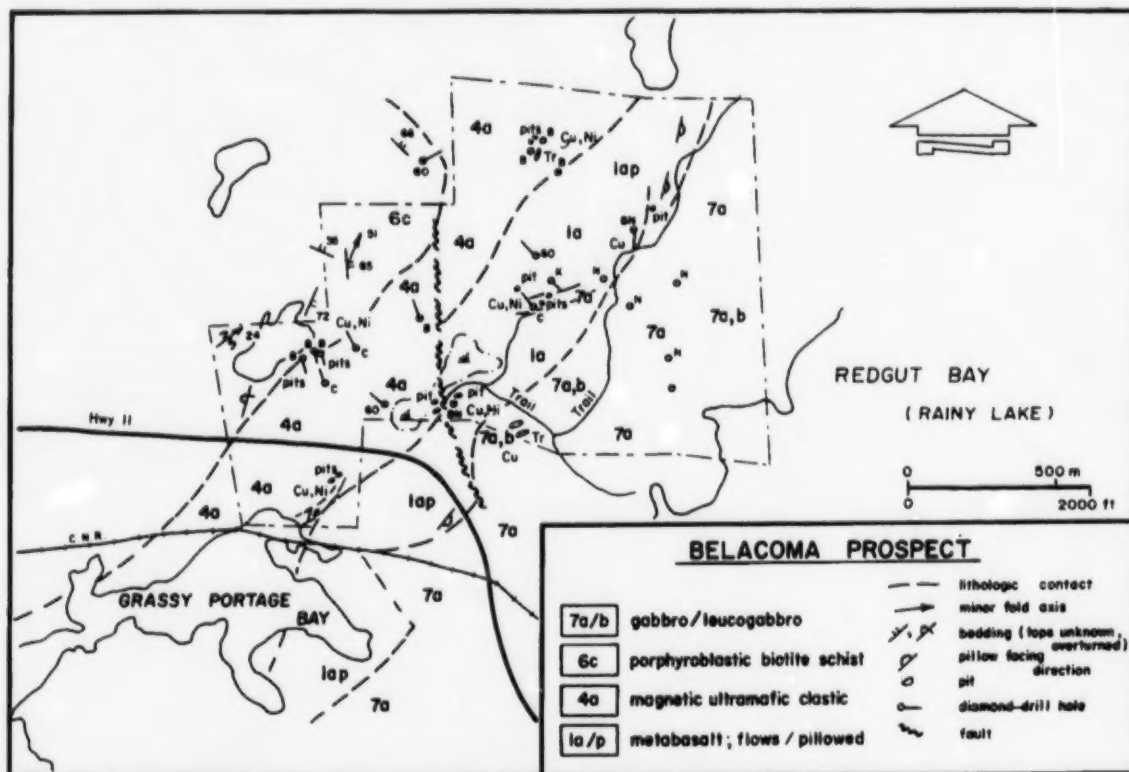


Figure 21. Geology of the Belacoma prospect (adapted from Harris (1974), private company reports, and the Resident Geologist's files, Ministry of Northern Development and Mines, Kenora, with new mapping by K.H. Poulsen). Other symbols as in Figure 16.

and range from melagabbro to leucogabbro in composition. Narrow dikes and sills, which are likely apophyses of the main intrusion, cut the ultramafic rocks and metabasalts.

MINERALIZATION: Disseminated pyrrhotite and chalcopyrite occur in 3 distinctive environments on this property:

1. associated with foliated ultramafic clastic rocks within a northeasterly striking shear zone along the northwestern margin of the property;
2. associated with narrow gabbroic sills and dikes which cut the ultramafic clastic unit and the metabasalts;
3. within the Grassy Portage intrusion near its base.

SIZE AND GRADE: All of the mineralized zones tested by diamond drilling have indicated low to very low grades of copper and nickel. The best reported drill intersection (Canico hole C, centre of the property) yielded 0.45% Cu, 0.12% Ni over 0.55 m, and the best grab samples from a shear zone at the metasedimentary-ultramafic unit contact reportedly assayed 0.29% Cu, 1.23% Ni and 0.17% Co (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). A drill intersection of 28.3 feet (8.62 m) yielded 0.08% Cu, 0.22% Ni across the same zone.

HISTORY:

1959-66: Mapping, electromagnetic survey and 5 diamond-drill holes ("N" series, see Figure 21) by Noranda Exploration Company Limited.

1967: Induced polarization and magnetometer surveys; 3 diamond-drill holes ("60" series, see Figure 21) by North 60 Explorers Limited.

1970: 1 diamond-drill hole ("K", see Figure 21) of 171 feet (52.1 m) by Kerr Addison Mines.

1972: Electromagnetic surveys by Cominco Limited and Hudson Bay Explorations Limited.

1973: Belacoma Mines; pits and trenches, 2 diamond-drill holes ("BN" series, see Figure 21).

1973: Electromagnetic and magnetic surveys and geological mapping by Canadian Nickel Company Limited; 2 diamond-drill holes totalling 691 feet (211 m) ("C" series, see Figure 21).

1974: One 295-foot (90 m) diamond-drill hole by Canadian Nickel Company.

1975: 5 diamond-drill holes ("B" series, see Figure 21) by Belacoma Mines.

1976: Trenching and 3 diamond-drill holes by Belacoma Mines.

1980: 2 diamond-drill holes south of Highway 11 by G. Armstrong. These were not located by the author.

SELECTED REFERENCES:

Harris 1974 (p.51)

Poulsen 1981

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

23. REDGUT BAY PROSPECT

LOCATION: Northwestern part of Halkirk Township, 5 km northeast of Nickel Lake station. Latitude 48°44.5'N, longitude 93°00.9'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Cu, Ni

CLASSIFICATION: Type 2A

GENERAL GEOLOGY: The property is underlain by ultramafic and mafic metavolcanic rocks, which have been intruded by gabbroic dikes and a lenticular granitoid body. The metavolcanic rocks are black amphibolites with a prominent northwesterly plunging mineral lineation, and ultramafic clastic rocks. The gabbroic intrusions are thought to be apophyses of the Grassy Portage intrusion, which outcrops in the western part of the property.

MINERALIZATION: Chalcopyrite and pyrrhotite occur as disseminations and fracture fillings in foliated metagabbro and in black hornblende schist adjacent to the gabbro. Diamond-drill records refer to the development of garnet and biotite zones within the metagabbro. These are characteristic of shear zones elsewhere in the Grassy Portage intrusion, and the black amphibolites may represent metamorphosed shear-zone rocks. The mineralized zone is conformable to and lies immediately to the east of magnetic ultramafic tuffs. A short electromagnetic conductor on the eastern margin of the property near Redgut Bay proved to result from graphitic schist.

SIZE AND GRADE: Four diamond-drill holes (ddh) through the copper zone intersected significant mineralization: ddh 66-2 —0.31% Cu over 17 m; ddh 66-3 —0.30% Cu over 6 m; ddh 67-28 —1.04% Cu over 4 m; ddh 67-1 —0.83% Cu over 1.5 m. The highest Ni value reported was 0.55% (Harris 1974). Trenching and diamond drilling have indicated a zone of mineralization approximately 1000 m long with a northwesterly strike.

HISTORY:

1959: Magnetic and electromagnetic surveys by Murray Mining Company Limited.

1966: Magnetic and electromagnetic surveys by Noranda Mines Limited; 6 diamond-drill holes.

1967: 6 diamond-drill holes by Noranda Mines Limited.

SELECTED REFERENCES:

Harris 1974 (p.71-73)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Shklanka 1969 (p.218-219)

24. POCKET POND PROSPECT (ARMSTRONG PROPERTY, BORDER CITY PROSPECT)

LOCATION: Straddling Highway 502, east of Pocket Pond. Latitude 48°44.2'N, longitude 93°03.7'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Zn, Mo, Cu

CLASSIFICATION: Types 1C, 1D

GENERAL GEOLOGY: The property is underlain by a southwestward-facing, northeastward-dipping sequence of metasedimentary and mafic metavolcanic rocks (Figure 22). The sequence strikes 305° and occupies the northeastern margin of the Rice Bay Dome. The metavolcanic sequence is composed of massive, foliated, and pillowed metabasalts, which have been metamorphosed to amphibolite facies assemblages containing hornblende with local diopside. Coarse-grained amphibolites may represent sills of metadiabase within the sequence. Ironstone and associated metasedimentary rocks occur at distinct horizons within the mafic volcanic sequence (see Figure 22). The metabasalts are overlain stratigraphically to the southwest by a 50 m wide zone of magnetic ultramafic clastic rock composed of actinolite, magnesian chlorite, minor talc, and magnetite. The rocks of this unit are commonly foliated and are intruded by medium-grained dikes composed of amphibolite. The metavolcanic sequence is overlain to the southwest by metasedimentary biotite schists containing altered garnets and sillimanite-bearing muscovite pseudomorphs after staurolite. Bedding markers within the metasedimentary sequence are parallel to those in the metavolcanic rocks.

MINERALIZATION: Sulphide and iron oxide mineralization occurs at 3 horizons within the metavolcanic sequence. From south to north, these are:

1. In the Main zone, *en échelon* massive sulphide lenses occur along the interface between a narrow siliceous amphibolite member to the north and a thick amphibolite to the south. The lenses are composed of pyrrhotite and pyrite with minor chalcopryrite and local molybdenite. A lens of massive pyrrhotite-sphalerite occurs locally at the main pit. A narrow layer of graphitic shale with local magnetite overlies the sulphide mineralization to the south.
2. In the No.9 zone, an extensive iron-rich formational unit extends northwesterly across the entire width of the property (see Figure 22). It is composed of laminated chert-magnetite iron formation, sulphide-bearing chert-magnetite iron formation and a narrow garnet-pyroxene-epidote marble. Total thickness of these units is approximately 25 m. A unit of pyritic black shale up to 10 m wide underlies the iron formation to the north. Pyrite-pyrrhotite-sphalerite concentration totals from 5 to 50% of this unit, and these sulphide minerals tend to occur as discrete bedding-parallel laminae. Minor chalcopryrite is also present.

3. In the North zone, folded chert-magnetite iron formation is exposed in pits 200 m north of the No.9 zone. The iron formation contains minor disseminated iron sulphide mineralization and lies in sharp contact with the medium-grained amphibolite to the south.

SIZE AND GRADE: Diamond drilling and trenching on the Main zone located less than 1 m widths of massive sulphide mineralization grading up to 14% Zn. This material proved to have limited lateral extent, and resulting grades averaged over 3 m widths yielded 1 to 2% Zn (M.W. Bartley, private company report, 1972). Low-grade massive sulphide mineralization on the same horizon to the west (holes 6 and 7, see Figure 22) yielded approximately 0.15% Zn over 5 m of core. A single assay returned 0.44% MoS₂ over 1 m. The 4 individual zones that occur at this particular horizon (see Figure 22) average 200 m long as determined by trenching, diamond drilling and geophysical surveys.

The No.9 zone has been tested by closely spaced diamond-drill holes for a length of 300 m. Few assay data are available but a typical intersection yielded 1.73% Zn, 0.09% Cu over a true width of 10 m (M.W. Bartley, private company report, 1972).

At the North zone, diamond-drill hole 66-3 encountered negligible base metal values.

HISTORY:

1966: Geophysical surveys and 1 diamond-drill hole by Noranda Mines Limited.

1971: Discovery of main showing by trenching by G. Armstrong.

1972-73: Magnetic and electromagnetic surveys; 12 diamond-drill holes (13 to 25).

1978: 4 diamond-drill holes (98 to 101).

SELECTED REFERENCES:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

25. NORANDA POCKET POND PROSPECT

LOCATION: Straddling Highway 502, northeast of Pocket Pond. Latitude 48°44.8'N, longitude 93°04.0'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Cu, Fe

CLASSIFICATION: Type 1D

GENERAL GEOLOGY: The property is underlain by pillowed to foliated metabasalts with intercalated iron-rich metasedimentary units. The rocks strike 305° and dip moderately northeastward. While intense flattening of the pillow lavas prevents their use as younging direction indicators, the volcanic sequence here appears to be conformable with the southwestward-facing sequence exposed on the Pocket Pond prospect to the south (see property 24). The rocks have been metamorphosed to amphibolite facies assemblages.

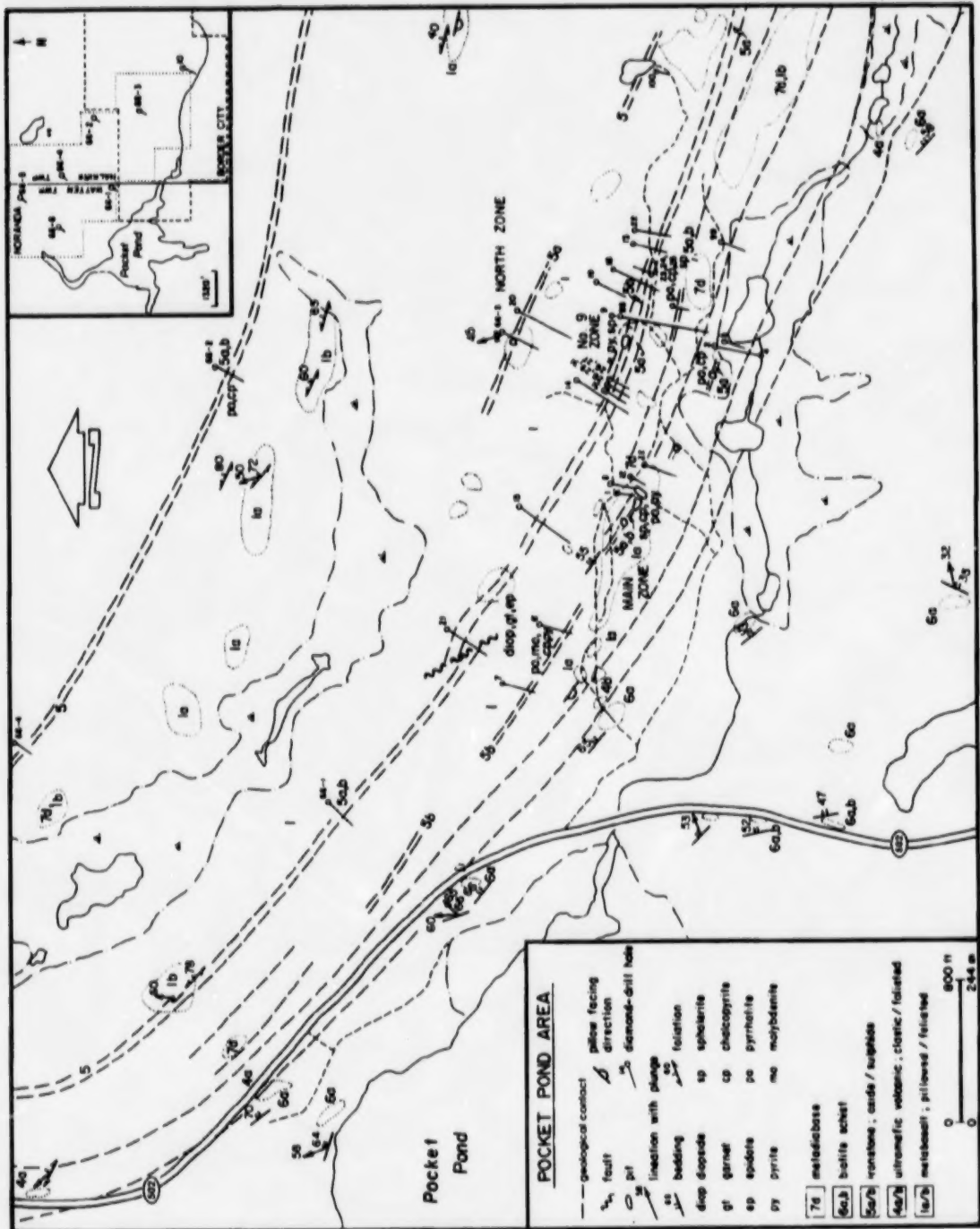


Figure 22. Geology of the Pocket Pond area (geology by K.H. Poulsen in 1980, with reference to private company reports). Other symbols as in Figure 16.

MINERALIZATION: Two extensive iron formation units parallel each other across the extent of the property (see Figure 22). The southernmost unit represents the north-westward extension of the No.9 zone of the Pocket Pond prospect (property 24). Here, chert-magnetite and minor iron sulphide mineralization are dominant. The northernmost iron formation is hosted by intercalated biotitic and amphibolitic schists, and is composed of minor chert-magnetite with narrow sulphide zones composed predominantly of pyrrhotite with minor chalcopryrite.

SIZE AND GRADE: Two diamond-drill holes testing the southernmost zone failed to encounter significant base metal values. Diamond-drill hole 66-2 (see Figure 22) returned 0.125% Cu over 2 m in the northern unit.

HISTORY:

1966: Electromagnetic survey and 5 diamond-drill holes by Noranda Mines Limited.

SELECTED REFERENCES:

Harris 1974 (p.76)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

26. McTAVISH PROSPECT

LOCATION: South of Highway 11, east of Nickel Lake, Watten Township. Latitude 48°42.4'N, longitude 93°06.0'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Zn, Cu

CLASSIFICATION: Types 1C, 1D

GENERAL GEOLOGY: The rocks underlying the property occupy the nose of the eastward-closing Nickel Lake synform (Figure 23). Minor structures suggest a shallow westward plunge to the synform, but younging direction criteria in pillowed basalts indicate eastward younging: the synform is a downward-facing fold. Mafic and ultramafic metavolcanic rocks form much of the succession and are intercalated with sulphide- and oxide-rich ironstone and related clastic metasedimentary rocks. Medium- to coarse-grained amphibolite forms concordant masses within the sequence. Most are thought to be metadiabase but some may represent thick flow units recrystallized to amphibolite facies assemblages. The amphibolite masses lack internal structures diagnostic of a volcanic origin. Truncation of stratigraphic markers has been interpreted as evidence of fault boundaries to the synform at the north-western and southwestern corners of the property. Porphyroblastic biotite schist occurs on the eastern side of the property.

MINERALIZATION: Base metal sulphide mineralization occurs in association with ironstone at a number of localities on the property, with the most significant concentra-

tions developed at the No.1 and No.10 zones (see Figure 23).

The No.1 trench exposes a westward-dipping sequence consisting of intercalations of 3 mineralized rock types. Schistose metachert with pyrite and pyrrhotite in contact with minor amphibolite gives way westward to intercalated pyritic shale and siliceous carbonate-sulphide rock which could be termed impure marble.

The black shale contains local laminae composed of coarsely recrystallized pyrite, sphalerite and minor chalcopryrite. These laminae appear to have formed at the expense of narrower, less clearly defined laminae of fine-grained pyrrhotite. Pyritic framboids are also present in the shale. The impure marbles are dolomitic and contain moderate amounts of fine-grained pyrrhotite and, locally, chalcopryrite. Coarse chalcopryrite, sphalerite and pyrite occur in rare seams and fractures in the marble.

At the No.10 trench, lean oxide iron formation is exposed. Adjacent to the iron formation, a black siliceous rock lacking diagnostic structures contains moderate chalcopryrite, pyrrhotite and magnetite as blebs 2 to 3 mm in diameter.

SIZE AND GRADE: Grab samples grading up to 4% Zn and 1.4% Cu have been reported from the No.1 trench. Surface chip sampling by Noranda Mines Limited in 1972 indicated a grade of 0.3% Zn, 0.09% Cu across the trench, with highest values (up to 0.55% Zn) occurring in the pyritic shale (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). Subsequent diamond drilling returned intersections of 0.22% Zn, 0.13% Cu and 0.14% Zn, 0.12% Cu over 3 and 4 m widths, respectively. These zones are separated by a 4 m wide barren unit. Similar material has been encountered in pits for over 1000 m along strike to the southeast.

Diamond drilling under the No.10 trench indicates 0.18% Cu over 5.6 m. No lateral continuation of the zone has been established.

HISTORY:

1951: Held by Brudon Enterprises; at least 3 pits established by that time.

1972: Trenching by K. McTavish; option to Noranda Mines Limited. Sampling, magnetic, VLF and electromagnetic surveys, and 2 diamond-drill holes.

1977: 4 diamond-drill holes at No.10 trench by G. Armstrong; geological mapping of western part of property.

SELECTED REFERENCES:

Davies, J.C. 1977

Harris 1974 (p.76)

Hewitt 1967 (p.43)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Shklanka 1968 (p.307)

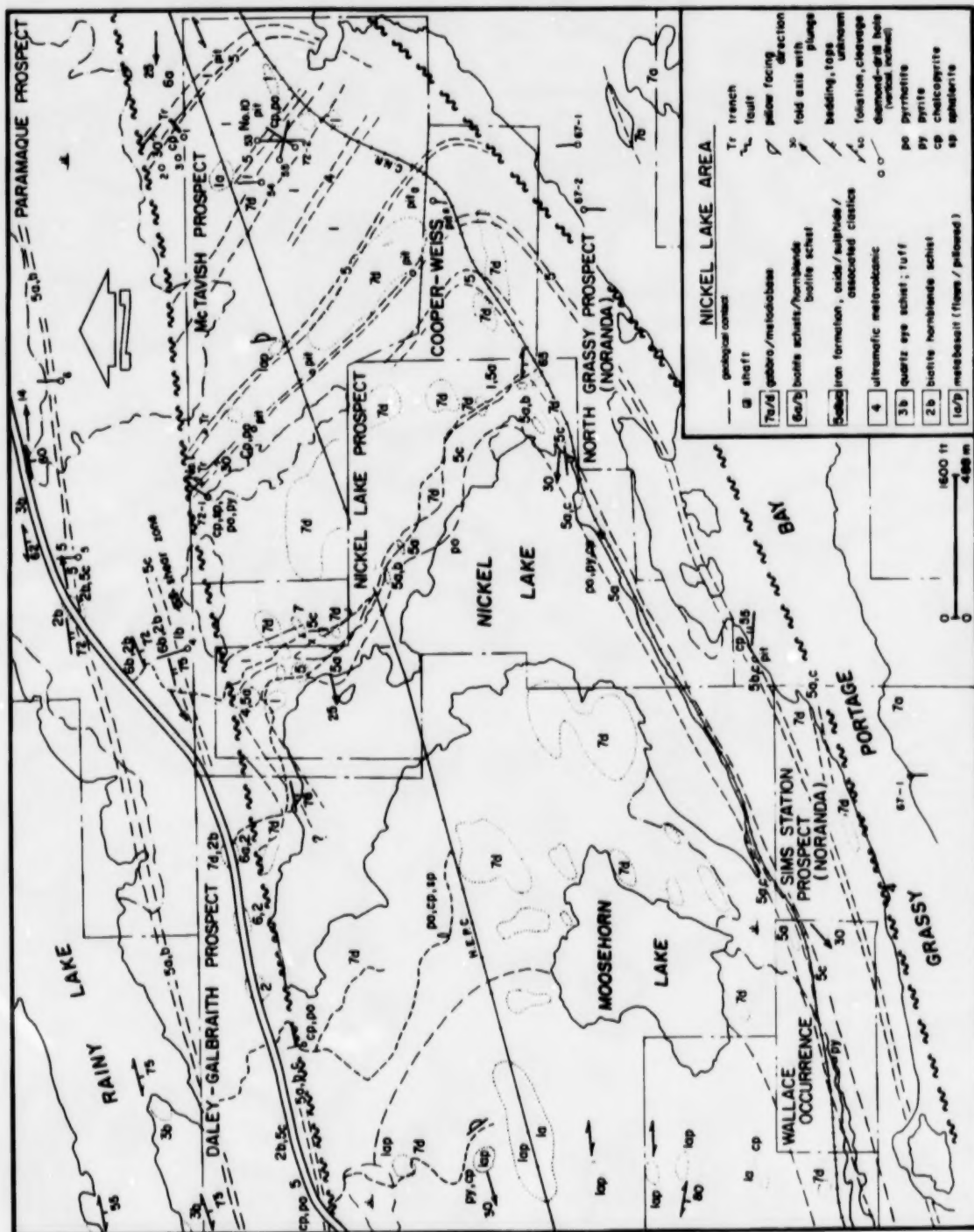


Figure 23. Geology of the Nickel Lake area (geology by K.H. Poulsen and assistants in 1980; in part adapted from the Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). Other symbols as in Figure 16.

27. PARAMAQUE PROSPECT

LOCATION: Adjacent to Highway 11, northeast of Nickel Lake. Latitude 48°42.8'N, longitude 93°05.8'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Type 1C

GENERAL GEOLOGY: The bulk of the property is underlain by intercalated mafic to felsic metavolcanic rocks and minor metasedimentary rocks. This sequence dips steeply southward and the combined effects of amphibolite facies metamorphism and high strain magnitudes have obliterated primary structures that might have allowed determination of younging directions. A fault striking 260° has been interpreted to bound this sequence near the southern margin of the property, where northwesterly striking units of the Nickel Lake synform (see Figure 23) are truncated. The rocks south of the fault consist of metabasalt, metadiabase and biotite schist (see property 26, the McTavish prospect).

MINERALIZATION: Three main zones occur on the property, 2 of which lie north of the inferred fault. The northernmost zone roughly parallels the highway across the entire width of the property as defined by mapping, geophysics and diamond drilling. Heavy concentrations of pyrite occur in siliceous schists that are intercalated with biotite-hornblende schist and amphibolite. The sequence, which is interpreted to be a highly deformed, metamorphosed volcano-sedimentary succession, is cut by quartz- and feldspar-phyric granitoid dikes and sills. The mineralization is stratiform.

A zone of lesser extent parallels the first zone to the south and reportedly consists of oxide iron formation with negligible sulphide mineralization. To the south of the fault, a northwesterly striking unit of lean oxide iron formation contains moderate pyrrhotite with some chalcopyrite. Wall rocks are dominantly amphibolite.

SIZE AND GRADE: The northern zones were tested by isolated diamond-drill holes and yielded no significant mineralization.

The southern zone was tested by trenching and diamond drilling. Assays of 0.1% Cu and 0.25% Cu over core widths of 15 and 16 m, respectively, were reported (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). Best intersections of 1.39% Cu and 0.6% Cu, over 0.6 and 1.1 m, respectively, were obtained.

HISTORY:

1966: Electromagnetic, magnetic and geological surveys by Paramaque Mines Limited; trenching and 6 diamond-drill holes (see Figure 23).

SELECTED REFERENCES:

- Harris 1974 (p.75-76)
- Hewitt 1967 (p.46)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Shklanka 1969 (p.221)

28. NICKEL LAKE PROSPECT (FONTANA PROPERTY, AINLEY PROPERTY)

LOCATION: Along the eastern shore of Nickel Lake, Watten Township. Latitude 48°41.7'N, longitude 93°06.2'W.

Map reference: NTS 52 C/11NE

COMMODITIES: S, Fe, Cu

CLASSIFICATION: Types 1C, 1D

GENERAL GEOLOGY: The property is underlain by rocks that occupy the hinge of the westward-plunging Nickel Lake synform. Medium- to coarse-grained amphibolite is interpreted to be metadiabase, and fine-grained varieties are interpreted to be metabasalt. Sulphide and oxide facies of iron formation and associated metasedimentary rocks occur within the mafic rocks. Minor folds in the iron formation indicate a plunge of 25 to 30° west for the synform.

MINERALIZATION: The bulk of the iron formation consists of chert-magnetite ironstone. Silicate intercalations composed of grunerite + actinolite + hornblende are common (Anglin 1982). Along the southern shore of Nickel Lake a unit of massive sulphide mineralization in black shale lies to the south of, and conformable to, the oxide mineralization. Sulphide mineralization consists of pyrrhotite-rich schists in which poorly developed sulphide lamellae are present, and coarse-grained, locally porphyroblastic, massive pyrite with minor chalcopyrite and sphalerite. Shale and schist fragments, 1 to 4 cm wide, are common in the sulphide mineralization. Chalcopyrite with pyrrhotite also occurs locally as disseminations and fracture fillings within amphibolites adjacent to the iron formation unit.

SIZE AND GRADE: The iron formation extends for at least 3.5 km across the property. No estimates of thickness are possible because of intense folding. Sulphide specimens assayed only trace amounts of copper (Harris 1974).

HISTORY:

1902: Discovered during construction of the Canadian National Railway; diamond drilling.

1918-19: 75-foot (23 m) shaft with 35-foot (11 m) drift through the sulphide zone.

1958: Evaluation and reconnaissance magnetic survey of iron formation by Cliffs of Canada Limited.

SELECTED REFERENCES:

- Anglin 1982
- Coleman 1902 (p.134-135)
- Harris 1974 (p.44-46)
- Hewitt 1967 (p.44)

Robinson 1920 (p.17-18)
Sutherland 1920 (p.67-68)

29. DALEY-GALBRAITH PROSPECT

LOCATION: South of Highway 11, northwest of Nickel Lake, Watten Township. Latitude 48°42.3'N, longitude 93°07.9'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Cu, Ni

CLASSIFICATION: Types 1C, 2A

GENERAL GEOLOGY: The property is underlain by rocks of the westward-plunging Nickel Lake synform. Pillow lavas, metagabbro and pelitic metasedimentary rocks with iron formation constitute most of the succession. Eastward-facing pillow lavas exposed on the property suggest that the synform is stratigraphically anticlinal, and a fault is interpreted to cut the northern limb of the structure (see Figure 23). Amphibolite facies mineral assemblages are present.

MINERALIZATION: Scattered sulphide mineralization occurs at 4 locations on the property (see Figure 23). Massive sulphide mineralization is exposed with chert-magnetite, graphitic shale and pelitic metasedimentary rocks to the north of the interpreted fault. A lens 1 to 2 m thick contains pyrite, pyrrhotite and minor chalcopyrite. It is hosted by siliceous metasedimentary rocks with disseminated pyrite and pyrrhotite, which are in turn hosted by intercalated shale, biotitic and locally garnetiferous siltstone and plagioclase-hornblende schist of probable volcanic origin.

A second showing lies 500 m to the southeast near the interpreted trace of the fault. A 2 m wide shear zone occurs in metasedimentary rocks at the contact with metadiabase. Pyrite and pyrrhotite with minor chalcopyrite and sphalerite have been reported.

The third showing lies between Moosehorn Lake and Nickel Lake. Hornblende gabbro and foliated hornblende schist contain abundant pyrrhotite with minor chalcopyrite.

Disseminated sulphide minerals occur in shear zones and pillow rims in deformed metabasalts at a fourth showing, approximately 800 m farther west. Pyrite and pyrrhotite are dominant but minor chalcopyrite has been reported.

SIZE AND GRADE: The massive sulphide mineralization exposed at the first showing is up to 2 m wide and 7 m long, and contains traces of copper and nickel (Harris 1974).

The third showing returned grab sample assays of 0.42% Cu. No assay data are available from the second and fourth showings.

HISTORY:

1963: Discovery of massive sulphide mineralization during highway construction.

1964-69: Trenching and diamond drilling (35 holes).

1973-74: Magnetic and electromagnetic surveys by V. Borschnek.

SELECTED REFERENCES:

Harris 1974 (p.48,49)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Shklanka 1969 (p.220-221)

30. SIMS STATION PROSPECT (Includes NORANDA SIMS, NORTH GRASSY and ROCKY ISLET BAY Groups)

LOCATION: On the northwestern shore of Grassy Portage Bay near Sims, in Watten Township. Latitude 48°41.0'N, longitude 93°08.8'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Types 1C, 1D, 2A

GENERAL GEOLOGY: The property is underlain by rocks that occupy the southern limb of the Nickel Lake synform (see Figure 23). Metabasalt, metadiabase, gabbro and ultramafic clastic rocks are dominant. Iron formation with associated pelitic metasedimentary rocks is intercalated with the mafic and ultramafic rocks. A fault is interpreted to mark the northern contact of the ultramafic rocks that underlie Grassy Portage Bay (see Figure 23).

MINERALIZATION: At least 2 parallel iron formation units strike 265° across the entire property. The northernmost unit (not shown on Figure 23) is oxide-rich and correlates with the main iron formation of the Nickel Lake prospect (see Figure 23). The southernmost unit likely represents the southwestward extension of the No.1 vein showing on the McTavish prospect. It consists of a siliceous metasedimentary host rock, chert-magnetite iron formation and laminated pyrrhotite and pyrite in a sedimentary matrix. Chalcopyrite is commonly present in minor quantities. Minor pyrrhotite and chalcopyrite have been reported from drill core which intersected the Grassy Portage intrusion to the south.

SIZE AND GRADE: Each type of mineralization has been tested by diamond drilling. A single hole, 2400 m west of Sims, intersected 0.09% Cu over 13 m of the northern iron formation. Two intersections grading 0.22% Cu over 7 and 13 m, respectively, were obtained from a single drill hole through the southern iron formation 1600 m southwest of Sims. An intersection through the same zone 1000 m to the east returned 0.2% Cu over 7 m. Diamond drilling from Grassy Portage Bay intersected trace sulphide mineralization in the magnetic ultramafic clastic unit and in the Grassy Portage intrusion. Pyrrhotite, pyrite and chalcopyrite were noted but no assay data are available.

HISTORY:

1918(?): Trenching on iron formation.

1959: 4 diamond-drill holes on Sims Group.

1966-67: 2 diamond-drill holes on Sims Group, 2 on North Grassy Group; geological mapping.

1969-70: Trenching, electromagnetic and magnetic surveys, and 3 diamond-drill holes on Rocky Islet Group southwest of Sims.

SELECTED REFERENCES:

Harris 1974 (p.73-75)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

31. BRUNETTE PROSPECT (WINDY POINT BRIDGE PROPERTY, MURRAY PROPERTY)

LOCATION: Straddling Highway 11, near Windy Point bridge, Watten Township. Latitude 48°41.3'N, longitude 93°11.7'W.

Map reference: NTS 52 C/11NE

COMMODITIES: S, Fe, Cu

CLASSIFICATION: Type 1D

GENERAL GEOLOGY: The property is underlain by highly deformed pillow lavas metamorphosed to amphibolite facies assemblages. A steeply plunging, westerly trending mineral lineation is subparallel to the long axis of elongate pillows. This strain obscures primary pillow shapes, but a few fairly good exposures suggest that the sequence faces southward at this locality. Pelitic metasedimentary rocks with associated iron formation occur within the pillow lavas.

An iron formation located on the property dips steeply northward and strikes subparallel to Highway 11. Minor folds in the iron formation plunge 60° west.

MINERALIZATION: Pyrite, up to 50% by volume, with minor pyrrhotite occurs in a siliceous biotite schist. Minor chalcoppyrite is present, and chert-magnetite occurs along the southern margin of the iron formation.

SIZE AND GRADE: The iron formation is exposed along the highway for a strike length of greater than 700 m, and aeromagnetic data suggest that this zone is part of a unit that is at least 5 km long. The width of the entire zone is approximately 50 m, and the sulphide-rich portion is reportedly 5 to 7 m wide (J.E. Gill, private company report, 1951). A chip sample of representative sulphide material gave only traces of copper and nickel (Harris 1974).

HISTORY:

1918: Trenching and diamond drilling by Grasselli Chemical Company.

1951: Evaluated by Brudon Enterprises as a pyrite prospect.

SELECTED REFERENCES:

Harris 1974 (p.60-61)

Hewitt 1967 (p.42)

Robinson 1920 (p.16)

Shklanka 1968 (p.306)

32. STANOL PROSPECT (REEF POINT PROSPECT, DOULEY PROPERTY)

LOCATION: On Reef Point Road, Watten Township. Latitude 48°41.2'N, longitude 93°14.2'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Fe, Cu

CLASSIFICATION: Type 1D

GENERAL GEOLOGY: Intensely foliated amphibolitic and biotitic schists strike east across the property. Steeply plunging folds are common and extreme tectonic flattening has obscured most primary features. Locally, relict fragmental textures of probable volcanic origin are preserved. Dikes, sills and irregular masses of granitoid composition commonly cut the metavolcanic and metasedimentary sequence.

MINERALIZATION: Lenticular bodies of stratiform iron formation occupy the contact between biotite schist to the north and amphibolite to the south. At the main pit, a sulphide lens approximately 70 m long lies adjacent to massive magnetite. The sulphides are pyrrhotite, pyrite and minor chalcoppyrite. Some chalcoppyrite also occurs in the coarsely recrystallized magnetite, which is cut by a 5 m wide sill of granitic composition. Recrystallized quartz laminae within the magnetite suggest that this unit represents recrystallized lean chert-magnetite with upgrading due to remobilization of silica. Similar lenses are exposed 500 m east and west of the main pit.

SIZE AND GRADE: The exposed lenses are typically 100 m long. At the main pit, the sulphide zone ranges up to 5 m wide while the magnetite zone averages 2 m in width. Grades ranging from 29.48 to 6.82% Fe have been reported from small core samples from the main zone.

HISTORY:

1954-56: Dip needle survey and short drill holes by Stanol Minerals Limited; 2000 tons mined for mill test.

SELECTED REFERENCES:

Harris 1974 (p.50)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Shklanka 1968 (p.307)

33. ROCKY ISLET BAY PROSPECT (YOUNG PROPERTY)

LOCATION: Between Rocky Islet Bay and Hopkins Bay, Watten Township. Latitude 48°42.7'N, longitude 93°11.7'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Cu, Fe

CLASSIFICATION: Types 1C, 1D

GENERAL GEOLOGY: A northeasterly striking iron formation 3 km long is hosted by intensely foliated, steeply dipping metavolcanic rocks of intermediate composition. Polymictic conglomerate forms a unit that parallels the iron formation to the west. The metavolcanic and metasedimentary rocks are intruded by porphyritic monzonite and quartz monzonite, as well as by granite of the Rocky Islet complex to the east and west. High magnitudes of strain prevent unequivocal interpretation of metavolcanic and metasedimentary types, but the conglomerate locally contains clasts of iron formation.

MINERALIZATION: The mineralization consists of disseminated to moderately massive pyrrhotite, with pyrite stringers closely associated with stratiform recrystallized magnetite. Chalcopyrite occurs locally with the iron sulphide mineralization. At the main showing, iron formation has been assimilated by a phase of the Rocky Islet complex.

SIZE AND GRADE: While the iron formations are laterally extensive, copper mineralization is found only locally. At the main showing, grades of up to 0.5% Cu have been reported in an iron formation inclusion up to 20 m long (Harris 1974).

HISTORY:

1956: Magnetic survey and geological mapping by Stratmat Limited; 17 diamond-drill holes.

SELECTED REFERENCES:

Harris 1974 (p.77-78)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Shklanka 1969 (p.221)

34. BEAR PASS PROSPECT (SMITH—COUSINEAU PROPERTY)

LOCATION: On Highway 112 at Bear Pass bridge, Halkirk Township. Latitude 48°41.4'N, longitude 93°00.0'W.

Map reference: NTS 52 C/10NW

COMMODITY: Mo

CLASSIFICATION: Type 3B

GENERAL GEOLOGY: The mineralization occurs at the southeastern margin of the Bear Pass pluton. The intrusion is composed of equigranular granodiorite, and cuts south-

easterly dipping metasedimentary biotite schists, which are concordant with the northeasterly trending antiformal structure of the body (Figure 24). Porphyroblasts up to 2 cm in diameter likely represent pseudomorphs after andalusite and cordierite. Only sericite and chlorite remain as alteration products.

MINERALIZATION: At the main showing, a northerly to northwesterly striking array of quartz-filled joints and shear fractures transect the Bear Pass pluton and are particularly abundant near its southeastern margin. The veins dip subvertically and form sharp planar walls on the granodiorite. Fine-grained grey quartz is the primary vein filling, and is locally accompanied by pyrite, or pyrite plus molybdenite. The molybdenite occurs as disseminations or as prominent slickensides within the veins and also as disseminations in wall rocks adjacent to the veins. "Bleached" alteration selvages around veins are rare, but may be accompanied by coarse muscovite and potassium feldspar. Veins range from 0.5 to 30 cm wide and are typically spaced 30 to 100 cm apart. Molybdenite-bearing veins occur in clusters.

A second occurrence lies 2600 m north-northeast of the Bear Pass bridge. Here, quartz veins with pyrite and molybdenite cut both biotite schist and granodiorite dike rocks. Pyrite is also enriched in wall rocks adjacent to the veins, and some veins contain muscovite, garnet and biotite.

SIZE AND GRADE: The main mineralized zone covers an approximate area of 0.6 by 0.2 km² as defined by the general presence of molybdenite in the veins. Diamond-drill intersections through this zone just to the northeast of the bridge typically yielded less than 0.05% MoS₂, with a best intersection of 0.6% MoS₂ over 1.7 m.

HISTORY:

1963: Discovered during highway construction.

1966: Magnetic, electromagnetic and geological surveys by International Nickel Company of Canada Limited; 5 diamond-drill holes (one, not shown on Figure 24, occurs to the northeast of the area).

SELECTED REFERENCES:

Harris 1974 (p.81-83)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

35. OTTERTAIL LAKE PROSPECT (LAKATOS AND COUSINEAU, ARMSTRONG)

LOCATION: Between Ottertail Lake and Tunnel Bay, Halkirk Township. Latitude 48°43.0'N, longitude 92°57.5'W.

Map reference: NTS 52 C/10NW

COMMODITIES: Cu, Zn, Mo, Ag

CLASSIFICATION: Types 1C, 1D, 3B

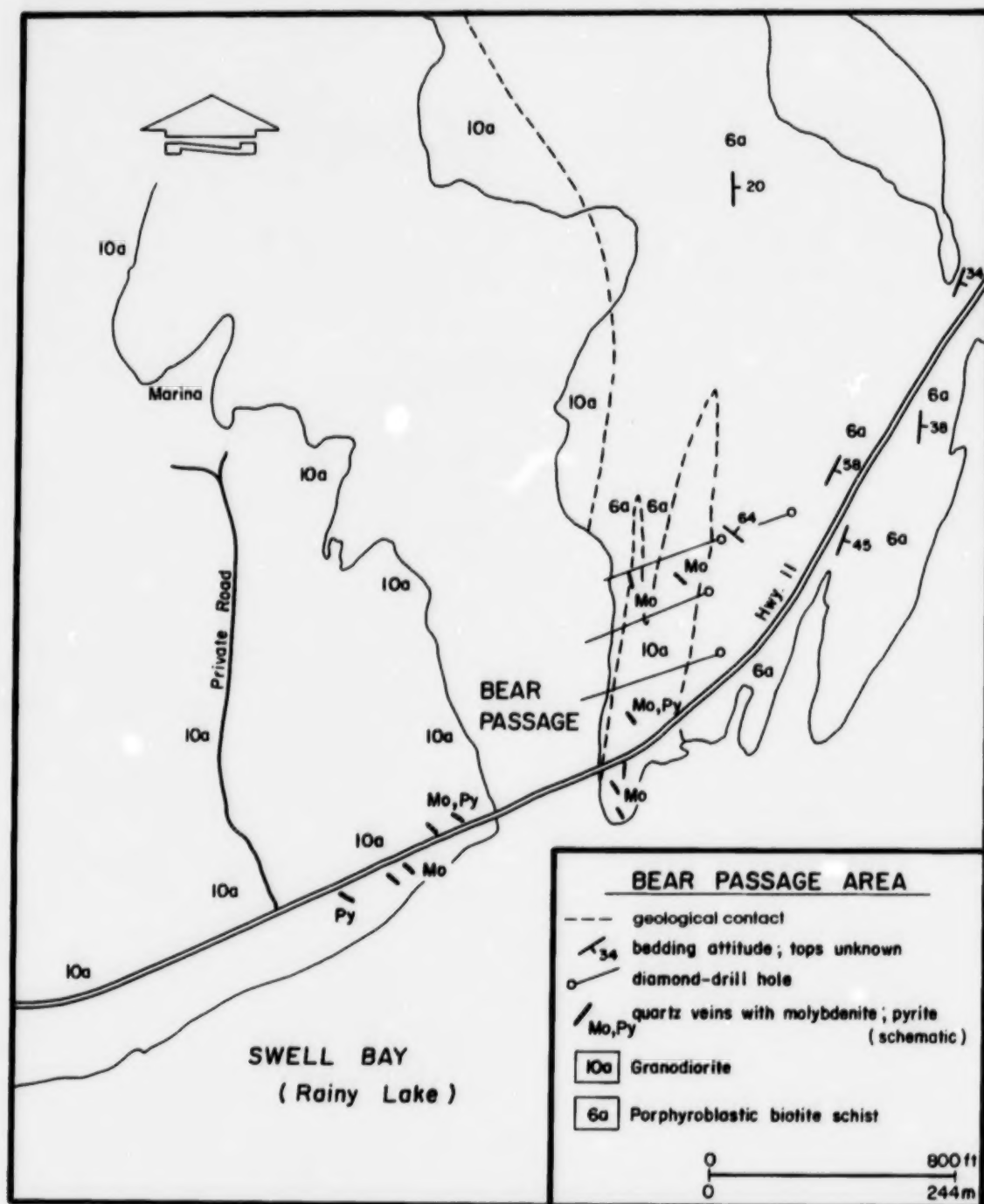


Figure 24. Geology of the Bear Passage area (geology by K.H. Poulsen in 1981). Other symbols as in Figure 16.

GENERAL GEOLOGY: A southeastward-facing sequence of metavolcanic and metasedimentary rocks underlies the property. Pillowed metabasalt with minor felsic to intermediate metavolcanic rocks are overlain to the south by a biotitic turbidite sequence. Iron formation and sulphide-bearing graphitic shale occur within and at the top of the metavolcanic sequence. Sills of gabbro and metadiabase cut the volcanic rocks, and the entire sequence is truncated to the northeast by granodiorite of the Ottertail Lake intrusion.

MINERALIZATION: Three mineralized zones occur on the property. Chalcopyrite and molybdenite occur in quartz veins and stringers associated with a granitoid dike approximately 1 m wide. The mineralization occurs at the contact between the Ottertail Lake granodioritic intrusion and metabasalt containing local iron formation.

Lean iron formation is intercalated with amphibolite and metagabbro near the power line to the south of the molybdenite showing. Magnetite is the dominant iron mineral with local pyrrhotite and pyrite.

Approximately 600 m south of the power line, base metal sulphide-bearing iron formation strikes 70° and is steeply dipping. The mineralization at the southern showing occurs in metasedimentary units intercalated with mafic, intermediate and felsic metavolcanic rocks. Pyrite, pyrrhotite and sphalerite occur as seams and disseminations in black shale. Chalcopyrite has also been reported in the felsic rocks. Banded oxide iron formation with minor garnet-epidote layers occurs within the metavolcanic rocks adjacent to the sulphide mineralization.

SIZE AND GRADE: All of the above zones have been tested by diamond drilling but few assay results are available. Grab samples of disseminated sulphide mineralization in rhyolite from the southern showing reportedly assayed an average of 0.27% Cu and 0.41 ounce per ton silver. Diamond-drill holes encountered the mineralized zone over a strike length of 2.5 km, with weak mineralization occurring over widths typically less than 5 m.

HISTORY:

1969: Discovery, trenching and 1 short diamond-drill hole by S. Lakatos and L. Cousineau.

1979: 6 diamond-drill holes by G. Armstrong.

SELECTED REFERENCE:

Harris 1974 (p.57-58)

36. YOUNG-CORRIGAN PROSPECT (SWELL BAY GOLD PROSPECT)

LOCATION: At the eastern end of Swell Bay near the Halkirk Township-Farrington Township boundary. Latitude 48°42'05"N, longitude 92°54'30"W.

Map reference: NTS 52 C/10NW

COMMODITIES: Au, Ag

CLASSIFICATION: Types 3A, 1D

GENERAL GEOLOGY: The property is underlain by steeply dipping slate, siltstone and oxide iron formation, intercalated with medium-grained amphibolite, which is likely of hypabyssal origin (Figure 25). These metadiabase sills are cut by numerous easterly striking, right-hand shear zones.

MINERALIZATION: Shear zones within the metadiabase contain foliated chlorite schist and central quartz veins, which locally contain pyrrhotite, pyrite, chalcopyrite, scheelite, chlorite, tourmaline and gold.

SIZE AND GRADE: The quartz veins strike approximately 110° and are steeply dipping. Five veins have been exposed on the property (see Figure 25).

The North Creek vein averages 10 inches (25 cm) in width and strikes 330°. Assays of 0.02 ounce per ton gold and 0.03 ounce per ton gold have been reported over 8 inches (20 cm) and 36 inches (91 cm), respectively.

The Shaft vein is 24 inches (60 cm) wide and strikes 280°. Harris (1974) reported assay values of nil Au for a grab sample.

The South Creek vein ranges up to 24 inches (60 cm) wide and strikes 290°. Values of 0.18 ounce per ton gold over 6 inches (15 cm) and 2.12 ounces of gold per ton over 24 inches (60 cm) have been reported.

The Main vein is a network of veins consisting predominantly of 2 branches, 5.2 inches (13 cm) and 11 inches (28 cm) wide, separated by a horse of chloritic schist. The veins yielded trace amounts of gold and 0.03 ounce per ton gold, respectively (this study). A diamond-drill intersection gave 0.19 ounce per ton gold over 38 inches (0.96 m) of core.

The South vein ranges up to 20 inches (50 cm) wide, and values of 0.04 ounce per ton gold have been reported over 19 inches (48 cm). Grab samples by Harris (1974) yielded 0.45, 0.61 and 4.24 ounces of gold per ton.

A bulk sample taken from the property in 1944 weighed 145 pounds and assayed 1.35 ounces of gold per ton and 0.22 ounce per ton silver.

HISTORY:

1890s: Lost Kelly Mine; 28-foot-deep (8.5 m) shaft.

1937: Staked by E. Corrigan; trenching, shallow drill holes.

1959: Property evaluation by Noranda Mines Limited.

1978: 11 diamond-drill holes plus stripping and trenching by G. Armstrong.

SELECTED REFERENCES:

Beard and Garratt 1976 (p.13)

Ferguson, Groen and Haynes 1971 (p.261)

Harris 1974 (p.46-48)

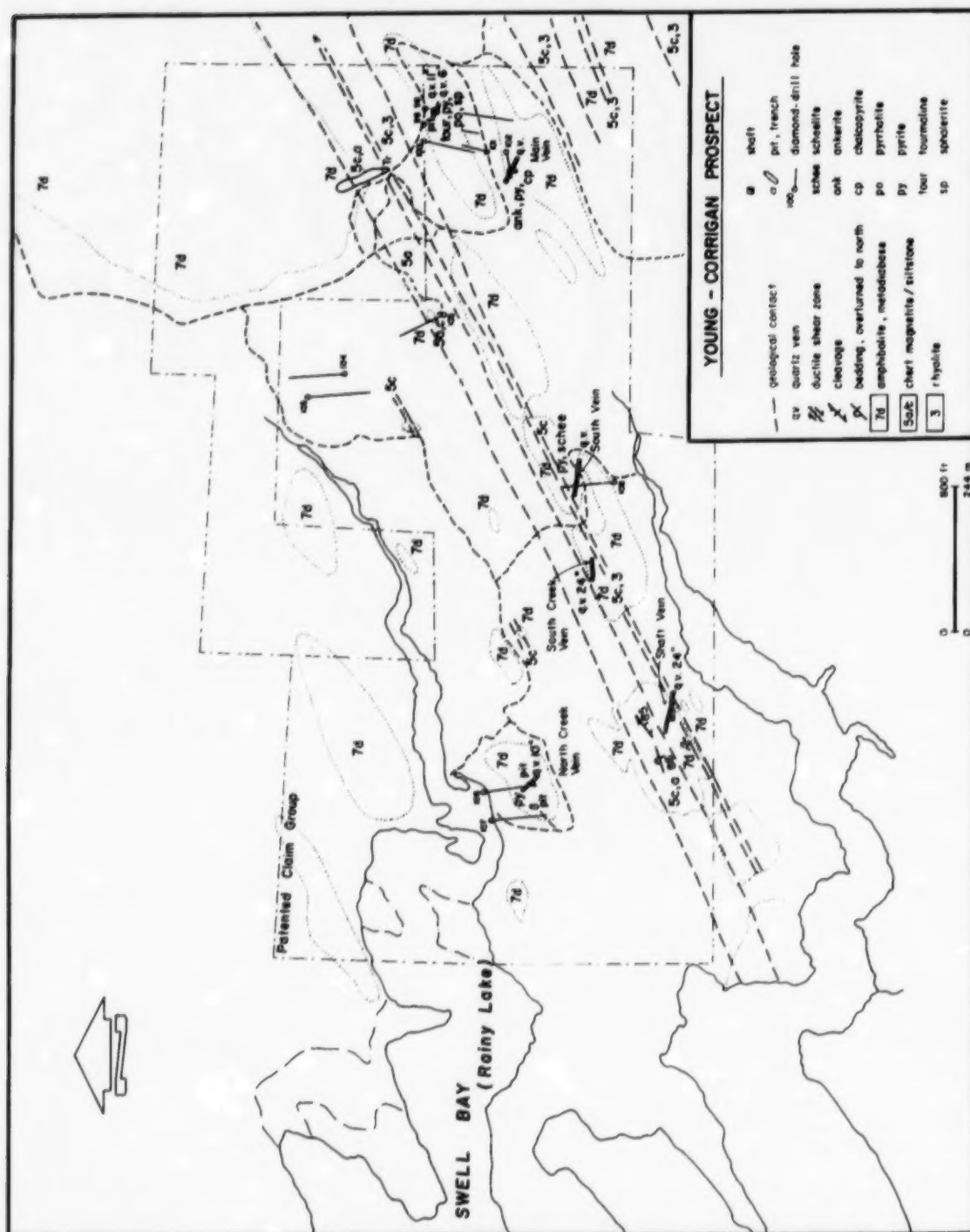


Figure 25. Geology of the Young-Corrigan prospect (geology by K.H. Poulsen and G. Laws in 1981). Other symbols as in Figure 16.

37. GAGNE LAKE PROSPECT (ARMSTRONG PROPERTY)

LOCATION: West Farrington Township. Latitude 48°42.2'N, longitude 92°53.0'W.

Map reference: NTS 52 C/10NW

COMMODITIES: Zn, Pb, Cu, Ag

CLASSIFICATION: Types 1A, 3A

GENERAL GEOLOGY: The property is underlain by felsic clastic metavolcanic rocks, siltstone, chert, and minor iron formation (Figure 26). Relatively coarse-grained amphibolites are interpreted to be mainly sills of metadiabase that cut the volcano-sedimentary sequence. Well-preserved graded beds in the eastern part of the property indicate a northward-younging sequence which is cut by the Ottetail Lake pluton to the northeast.

MINERALIZATION: Much of the mineralization exposed on the property occurs at the main pit and the west pits (see Figure 26). At the main pit, two stratiform zones, 10 and 20 cm wide, contain heavy concentrations of sphalerite and galena, with minor pyrite. Overlying these are 2 narrow parallel zones consisting mainly of pyrite. All of these zones are separated by 1 to 2 m wide zones of altered tuff and siltstone. Toward the footwall, chalcopryite occurs as disseminations and stringers in a 20 m wide chloritic alteration zone. This zone is characterized by ovoid pinitized cordierite and altered anthophyllite, which have developed in the contact aureole of the Ottetail Lake pluton. Coarse breccia associated with the mineralization overlying this alteration zone also shows this "dalmatianite" assemblage in matrix material interstitial to the siltstone blocks.

Mineralization in the west pits consists of a narrow stratiform zone containing moderate amounts of pyrite, again associated with cordierite and anthophyllite. Coarse breccia exposed in the footwall to the south contains clasts of massive pyrite up to 10 cm in diameter.

SIZE AND GRADE: A 14-inch-wide (36 cm) quartz vein from a shear zone in the metadiabase exposed in a beaver pond yielded trace amounts of gold and silver. Extensive diamond drilling in the area of the main and west pits has confirmed the persistence to depth of the very narrow widths of base metal mineralization, along with numerous intersections of "dalmatianite" along the 1 km horizon tested by the drilling. No assay data are available from the drill programs. A grab sample of massive sulphide mineralization from the main pit (this study) yielded 15.3% Zn, 0.03% Cu, 2.15% Pb, trace Au and 1 ounce per ton silver.

HISTORY:

1975: Discovered by prospecting by G. Armstrong and M. Hupchuk.

1976: Trenching and 16 diamond-drill holes (34 to 49).

1977: Geological mapping and 12 diamond-drill holes (62 to 73).

1979: 1 diamond-drill hole (109).

SELECTED REFERENCE:

Poulsen 1980b

38. WIND BAY PROSPECT

LOCATION: On a peninsula in Rainy Lake separating Swell Bay from Seine Bay, Halkirk Township. Latitude 48°40.0'N, longitude 93°58.4'W.

Map reference: NTS 52 C/10SW

COMMODITIES: Zn, Cu

CLASSIFICATION: Type 1B

GENERAL GEOLOGY: The property is underlain by intercalated metavolcanic rocks (Figure 27). In the south, a mixed sequence includes metabasalt, intermediate lapilli tuff, rhyolite tuff, lapilli tuff and a mafic clastic unit. This sequence is overlain to the north by a relatively homogeneous sequence of quartz-eye rhyolite tuffs, which are capped by chert-magnetite iron formation with associated clastic metasedimentary rocks. Minor pillowed basalts in this sequence, and rare graded metasedimentary rocks in the southern sequence, indicate a single northward-facing succession. Metadiabase and gabbroic sills, characterized by two chilled margins, epidote-rich alteration patches and local magnetite-ilmenite segregations, are up to 100 m thick and cut all levels of the volcanic stratigraphy. The rocks are locally intensely foliated with a 230° mean strike for the subvertical cleavage. A northerly striking fault (see Figure 27) is indicated by the abrupt truncation of the stratigraphic units. Greenschist facies metamorphic assemblages are present throughout.

MINERALIZATION: Mafic clastic rocks at the top of the southern volcanic sequence host stratabound low-grade zinc and copper mineralization. Much of the mineralization occurs as discrete seams of sphalerite, pyrrhotite, chalcopryite or pyrite 1 to 20 cm wide, separated by substantial widths (1 to 20 cm) of barren chloritic host rock. The seams are lenticular in nature and parallel the foliation in the chloritic schists. Where foliation is least intense, amygdules, quartz eyes and lithic fragments are discernible, and the mineralization appears to be more discordant, occurring as blebs and veinlets. The mineralized zone is intensely chloritic, and while a mafic fragmental parentage is suggested, local quartz-eye-bearing units suggest a more heterogeneous lithologic package that has been intensely altered. A zone of local intense alteration (see Figure 27) occurs within the felsic footwall rocks to the south of the mineralized zone. Pyritic blebs with local sphalerite and chalcopryite occur in felsic lapilli tuff and local chloritic agglomeratic tuff with angular felsic clasts.

SIZE AND GRADE: Zinc and copper mineralization has been defined by diamond drilling to occupy a zone over 4000 feet (1200 m) long and up to 150 feet (46 m) wide. Within this zone, *en échelon* lenses up to 10 m wide are mineralized and are separated by similar widths of barren host rock. Diamond-drill holes into the zone typically in-

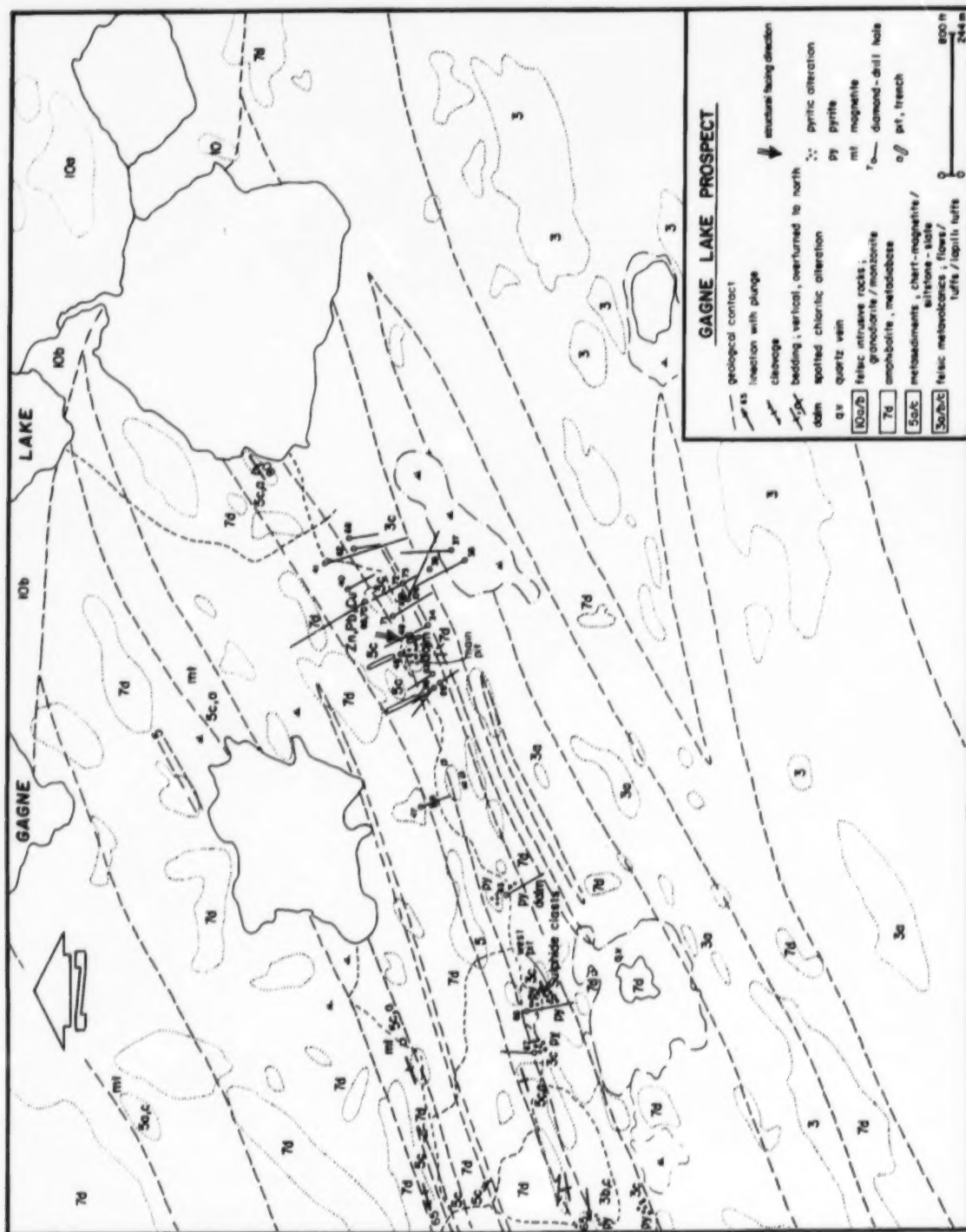


Figure 26. Geology of the Gagne Lake prospect (geology by K.H. Poulsen in 1981; in part adapted from a private company map by J.C. Davies). Other symbols as in Figure 16.

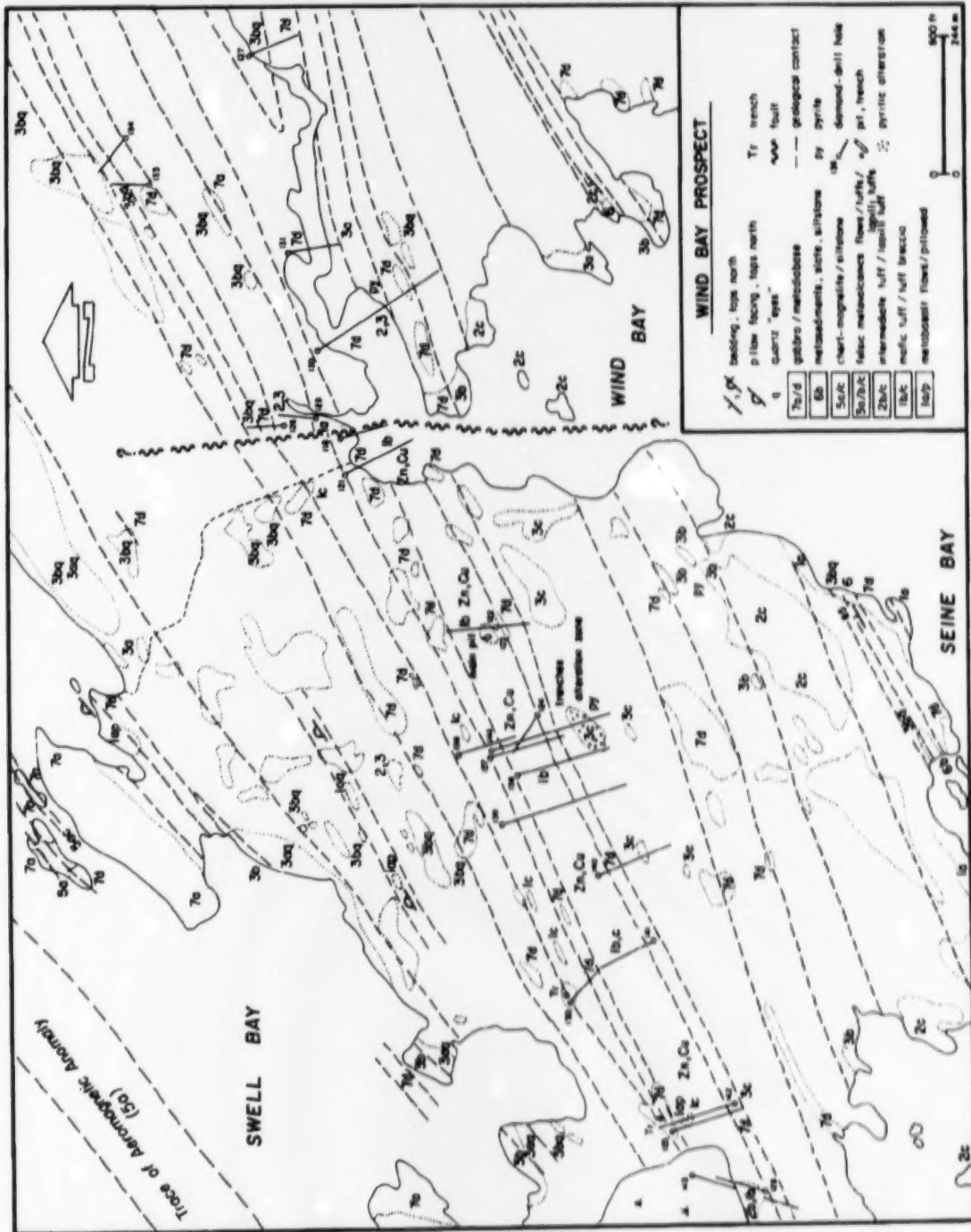


Figure 27. Geology of the Wind Bay prospect (geology by K.H. Poulson and W. Clendenen in 1980). Other symbols as in Figure 16.

tersect 2 or 3 lenses of this type and, while limited assay data are available, 2 such lenses encountered in a typical intersection (hole 118, *see* Figure 27) yielded 1.5% Zn, 0.2% Cu and 1.1% Zn, 0.09% Cu over 7 m and 8.6 m, respectively (G. Armstrong, Prospector, personal communication, 1980).

HISTORY:

1966: Discovery of alteration zone by J. Beaupre.

1967: Option to Noranda Mines Limited; electromagnetic surveys and channel samples.

1969: Trenching by M. Hupchuk on main zone.

1979-80: Stripping, trenching, 25 diamond-drill holes by G. Armstrong.

SELECTED REFERENCES:

Harris 1974 (p.54-56)

Poulsen 1980b

39. LOCHART LAKE PROSPECT (SELCO PROPERTY)

LOCATION: Western end of Lochart Lake, Farrington Township. Latitude 40°40.9'N, longitude 92°53.0'W.

Map reference: NTS 52 C/10NW

COMMODITIES: Cu, Zn

CLASSIFICATION: Type 1B

GENERAL GEOLOGY: The property is underlain by felsic to intermediate metavolcanic rocks with intercalated sills of metadiabase. The rock units strike 255° and are steeply dipping. Pillow structures in an andesite flow northwest of Lochart Lake indicate a northward-facing sequence. The metavolcanic rocks consist of mafic to intermediate tuff and lapilli tuff, overlain to the north by quartz-eye rhyolite and rhyolite tuff with local intercalations of pillowed andesite or basalt. The felsic rocks are locally amygdaloidal.

MINERALIZATION: Base metal mineralization has been reported in diamond-drill core that tested Selco Limited's "anomaly 15C". Massive pyrrhotite and pyrite with local chalcocopyrite occur in zones up to 5 m wide within chloritic tuff. Sphalerite, pyrite and chalcocopyrite are also reported as disseminations and seams within adjacent chloritic amygdaloidal rocks.

SIZE AND GRADE: Mineralization was encountered in 3 diamond-drill holes covering a strike length of 260 m. Assays of 0.32% Cu over 5 m have been reported for the massive iron sulphide mineralization. Thin sphalerite seams are reported over widths of 3 to 5 m, but no zinc values have been reported.

HISTORY:

1967: Geophysical surveys and 3 diamond-drill holes by Selco Limited.

1977: 3 diamond-drill holes by G. Armstrong approximately 1.5 km to the northeast of the Selco occurrence.

SELECTED REFERENCES:

Harris 1974 (p.80)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

40. FARRINGTON BOUNDARY PROSPECT (CANICO AND SELCO PROPERTIES)

LOCATION: East-northeast of Lochart Lake, on the eastern side of Farrington Township. Latitude 48°42.0'N, longitude 92°48.7'W.

Map reference: NTS 52 C/10NW

COMMODITIES: Zn, Cu

CLASSIFICATION: Type 1B

GENERAL GEOLOGY: The property is underlain by a steeply dipping sequence of metavolcanic rocks that strike 250°. The chlorite-rich tuffs, lapilli tuffs and amygdaloidal flows are overlain to the north predominantly by quartz-eye-bearing felsic flows and tuffs. Numerous narrow sills of metadiabase cut the volcanic succession. All rock types are locally intensely foliated.

MINERALIZATION: A discontinuous zone of base metal mineralization extends along strike across the property. Stratigraphically, the mineralization coincides with the transition from chloritic tuff to felsic compositions. The mineralization has been tested by diamond drilling in the west, central and eastern parts of the property.

In the west, a mineralized zone approximately 20 m wide was reported. The zone includes disseminated to massive pyrrhotite with cubes of pyrite and local magnetite. Sphalerite and chalcocopyrite occur with the iron sulphide mineralization, which commonly contains chloritic and talcose bands.

In the central part of the zone, mineralization consists of massive pyrrhotite and pyrite mineralization with minor chalcocopyrite.

In the east, narrow seams of pyrite, pyrrhotite, chalcocopyrite and sphalerite occur in intensely foliated chloritic host rock.

SIZE AND GRADE: Diamond drilling in the western part of the zone encountered sulphide mineralization over a substantial width. A weighted average of assays from one intersection yields 0.48% Zn, 0.13% Cu, and 0.03 ounce per ton silver over a core length of 26 m. No assay data are available for 2 holes testing the central part; average assays of 1.55% Zn, 0.08% Cu over 3.3 m, and 0.12% Zn, 0.14% Cu over 2.3 m have been reported from the eastern portion.

HISTORY:

1967: Geophysical surveys, 2 diamond-drill holes by Selco Exploration Company on eastern part of zone.

1976-77: Geophysical surveys and 5 diamond-drill holes across the zone by the Canadian Nickel Company.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

41. SEINE BAY IRON PROSPECTS (RYAN PROPERTY)

LOCATION: Along the northern shores of Seine Bay and Bad Vermilion Lake. Latitude 48°40.1'N, longitude 92°54.9'W.

Map reference: NTS 52 C/10NE, NW

COMMODITIES: Fe, Ti, V

CLASSIFICATION: Type 2C

GENERAL GEOLOGY: The property is underlain by the Seine Bay–Bad Vermilion Lake gabbroic intrusive complex. The body is 25 km long and up to 1 km wide. It strikes east-northeast to northeast and conforms to the attitudes of adjacent volcanic units. It may represent a single intrusion with a local fault-bounded southern margin, or part of the larger mass of anorthosite and gabbro exposed in the southern parts of the Seine Bay–Bad Vermilion Lake intrusion (see Figure 4). The intrusion is composed of equigranular medium-grained gabbro, leucogabbro and anorthosite, with disseminated magnetite and ilmenite occurring as common phases.

MINERALIZATION: Discontinuous lenses of ilmenite-magnetite occur along the length of the intrusion. Massive mineralization consists of closely packed grains of ilmenite and titaniferous magnetite averaging 1 to 3 mm in diameter. Interstitial chlorite, talc and local apatite form the remainder. Associated with massive lenses are enveloping zones that contain varying proportions of oxide grains. Oxide content generally decreases away from the lenses and grades into normal oxide-bearing gabbro and leucogabbro. Point counts of 10 samples (Lister 1966) indicate an average volumetric ratio of magnetite to ilmenite of 3.4:1.

SIZE AND GRADE: Early exploration indicated at least 2 000 000 tons of high grade titaniferous magnetite (Rose 1969). Subsequent evaluation by Stratmat Limited indi-

cated that, while oxide mineralization is present discontinuously along the entire intrusion, there are 3 areas that contain the best tonnage–grade characteristics: the West zone, 2 to 3 km east of Wind Bay; the Central zone between Lochart Lake and Seine Bay; and the East zone along the northern shore of the western part of Bad Vermilion Lake. Tonnages per vertical foot of material grading greater than 45% combined Fe-TiO₂ have been estimated as follows: West zone 23 000, Central zone 91 500, and East zone 30 000 (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). Analytical data for bulk samples and mineral separates reported by Rose (1969) and Lister (1966) are tabulated in weight % in Table 6.

There is a clear tendency for chromium and vanadium to be concentrated in magnetite-rich samples (Lister 1966).

HISTORY:

1911: Diamond drilling by Hunter of Duluth.

1917-18: Evaluation of East zone by W.L. Goodwin.

1943: 6 diamond-drill holes by Butler Brothers on the East and Central zones.

1956-58: Geological mapping, magnetic survey, diamond drilling and bulk sampling by Stratmat Limited on all zones.

SELECTED REFERENCES:

Harris 1974 (p.78-79)

Lister 1966

Parsons 1918 (p.176-183)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Robinson 1922

Rose 1969 (p.121-125)

Shklanka 1968 (p.295)

42. STANG PROSPECT

LOCATION: On the northwestern shore of Bad Vermilion Lake. Latitude 48°44.8'N, longitude 92°40.8'W.

Map reference: NTS 52 C/10NE

COMMODITY: Cu

CLASSIFICATION: Type 2A

Table 6. Analytical data for bulk samples and mineral separates, Seine Bay iron prospect.

	Fe%	Ti%	V%	Cr%	Source
275-pound (125 kg) bulk					
high grade	46.4	16.8	—	—	Rose 1969
low grade	27.1	3.5	0.072	—	Rose 1969
Oxide concentrates					
(average of 4)	54.5	13.9	0.182	0.058	Lister 1966
Ilmenite concentrates					
(average of 4)	38.3	26.7	0.072	0.032	Lister 1966
Magnetite concentrates					
(average of 10)	60.1	8.4	0.179	0.083	Lister 1966

GENERAL GEOLOGY: The property is underlain by coarse-grained gabbro and minor leucogabbro of the Seine Bay-Bad Vermilion Lake intrusion. A shear zone containing chloritic schist strikes 250°, parallel to the shore of Rainy Lake. Trondhjemitic dikes occur adjacent to the shear zone.

MINERALIZATION: Disseminated to locally massive pyrite occurs within talc-chlorite-carbonate schist within the shear zone and in adjacent trondhjemite. Coarse pyrite cubes are common, and minor pyrrhotite and chalcopryrite have been reported.

SIZE AND GRADE: A narrow mineralized zone averaging 1 m wide was defined by diamond drilling over a length of 600 feet (182 m) in a 1500-foot-long (460 m) shear zone. While drill logs contain references to minor chalcopryrite, no assay data are available.

HISTORY:

1955-56: Geological mapping, geophysical surveys and 30 diamond-drill holes by Stratmat Limited.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

43. STELLAR MINE

LOCATION: On the northwestern shore of Bad Vermilion Lake. Latitude 48°44.6'N, longitude 92°42.2'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: Sills of trondhjemite and gabbro underlie the property (Figure 28). A metadiabase dike cuts the trondhjemite in the north-central part of the property. Numerous southwesterly to northwesterly striking shear zones cut the otherwise homogeneous plutonic rocks.

MINERALIZATION: Lenticular quartz-carbonate veins occur within the shear zones in both metagabbro and trondhjemite. Foliated rocks adjacent to the veins show an alteration mineralogy of sericite + chlorite + carbonate in the case of the trondhjemite, and chlorite in the case of the gabbroic host. Ankerite, siderite, pyrite, galena, sphalerite and chalcopryrite are common in the veins, and fine-grained visible gold was noted in the No.2 vein. A copper-rich vein (No.6) contains abundant chalcopryrite, malachite and azurite.

SIZE AND GRADE: Of the numerous veins exposed on the property, the 5 most significant ones are described.

The No.1 vein is hosted by metagabbro, strikes 245° and dips 70° northwest. It is lenticular and ranges up to 30 inches (76 cm) wide. A sample across 30 inches (76 cm) just below the collar of the shaft reportedly yielded 0.3 ounce per ton gold.

The No.2 or Rainbow vein strikes 265° and dips steeply northward. The vein is lenticular and is reportedly 46 inches (117 cm) wide at a depth of 24 feet (7.3 m) from surface. Engineering reports indicate gold values ranging from 0.12 to 3.0 ounces of gold per ton with an erratic distribution of values.

The No.4 vein is vertical and strikes 245°. It is on the order of 18 inches (46 cm) wide and reportedly contains gold values.

The unnamed vein in the north-central part of the property ranges up to 24 inches (73 cm) wide, strikes 245° and is vertical. Gold values of 0.3 ounce per ton gold have been reported.

The No.6 vein strikes 330° and dips shallowly to the east. It ranges up to 36 inches (91 cm) wide, and a westward-striking branch is approximately 6 inches (15 cm) wide. This latter vein reportedly ran 3% Cu and 0.15 ounce per ton gold.

HISTORY:

1930: Owned and prospected by Miles, Stethen, and Associates.

1934: Stellar Gold Mines Limited No.1 shaft to 15 feet (4.5 m), No.2 shaft to 50 feet (15 m).

1975-78: Magnetometer and electromagnetic surveys, stripping, trenching and 2 diamond-drill holes by Ed-Vic Explorations (not shown on Figure 28).

SELECTED REFERENCES:

Beard and Garratt 1976 (p.38)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Tanton 1935 (p.5)

44. SOUTH VERMILION MINE (VERLAC, PACITTO)

LOCATION: On the northwestern shore of Bad Vermilion Lake. Latitude 48°45.3'N, longitude 92°39.6'W.

Map reference: NTS 52 C/15SE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: Trondhjemite and gabbroic sills cut intensely foliated quartz-chlorite schists that are likely of volcanic origin. Foliation strikes 255° and is vertical. Numerous shear zones cut the plutonic rocks.

MINERALIZATION: Laminated quartz veins occupy southwesterly to northwesterly striking shear zones. Vein and dump materials contain ankerite, siderite, pyrite, chalcopryrite, chlorite, tourmaline, malachite and erythrite.

SIZE AND GRADE: At least 6 veins have been exposed on this property. The No.1 vein strikes 290° and is vertical. It ranges up to 18 inches (46 cm) wide, and 3 samples across the vein reportedly averaged 0.375 ounce per ton gold over 12 inches (31 cm) for a length of 35 feet (11 m).

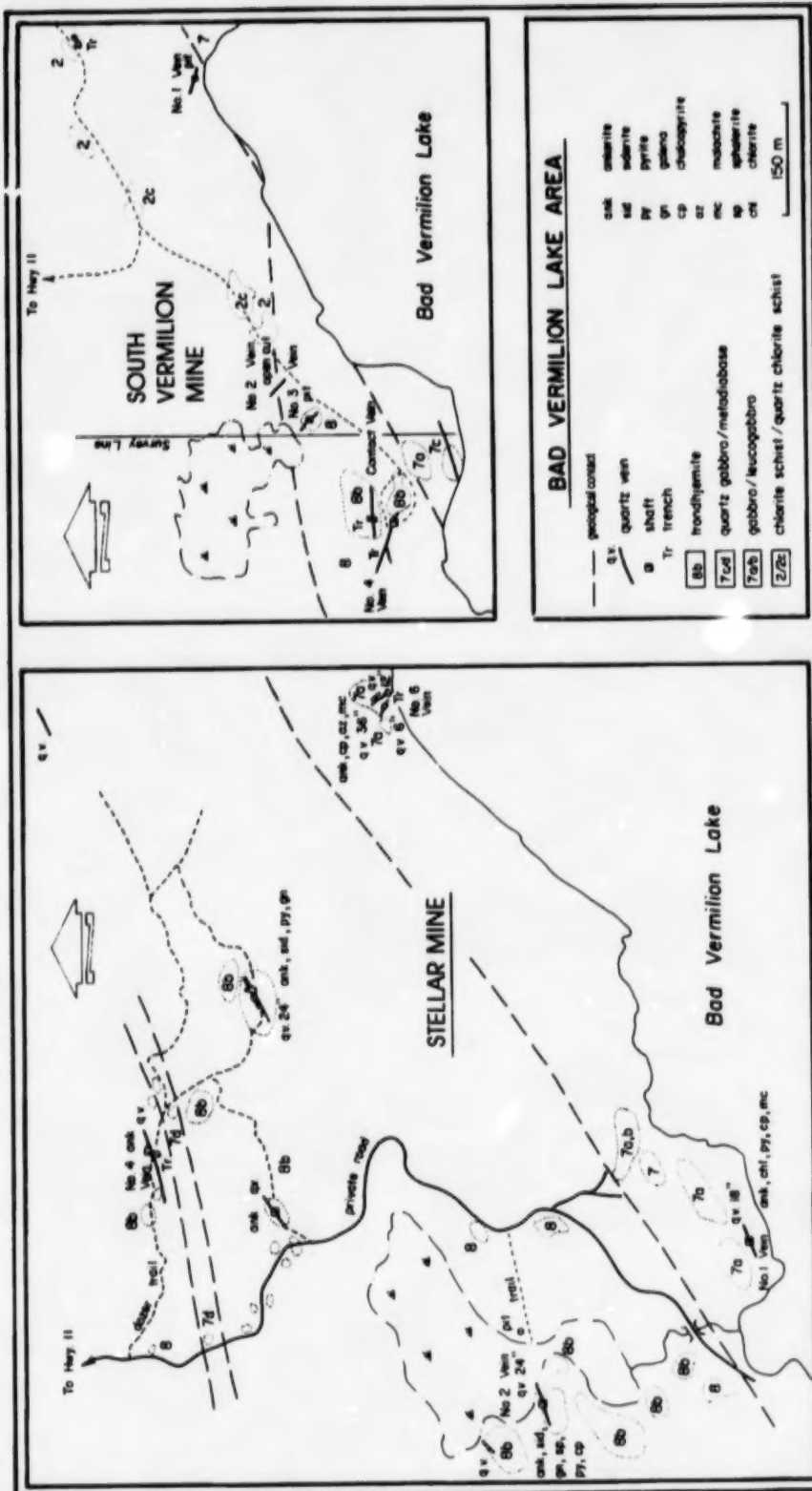


Figure 28. Geology of the Bad Vermilion Lake area (geology by K.H. Poulsen and G. Laws in 1981; with reference to the Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). Other symbols as in Figure 16.

The No.2 vein is vertical, strikes 310° and ranges up to 36 inches (92 cm) wide. Three assays of chip samples across the vein for a length of 15 feet (4.6 m) yielded an average of 0.33 ounce per ton gold over 1.7 feet (0.52 m) (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora).

The No.3 vein is 5 inches (13 cm) wide as exposed in a pit. It is vertical and strikes 320°. Gold values have been reported.

The No.4 vein strikes 290° and is vertical. As exposed on surface, the vein ranges from 8 to 36 inches (20 to 92 cm) wide. Channel samples across the vein in the shaft were reportedly erratic, ranging from 0.6 ounce per ton gold to greater than 3.0 ounces of gold per ton. A 12-inch-wide (30 cm) vein branches to the southwest.

The Contact vein strikes east, is vertical and ranges up to 48 inches (122 cm) wide. No assay data are available for this vein.

The Shoreline vein strikes 260° and, as exposed, is 42 inches (107 cm) wide. No assay data are available.

A 298-pound bulk sample from this property, possibly from the No.2 vein, assayed 0.98 ounce per ton gold, 0.34 ounce per ton silver, and 0.17% Cu.

HISTORY:

1935-39: Trenching, stripping and diamond drilling. Shaft on No.4 vein to 118 feet (36 m) and a small mill established.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.37)
- Sinclair 1936 (p.140)
- Sinclair 1937 (p.159)
- Sinclair 1938 (p.202)
- Sinclair 1940 (p.198)
- Tanton 1935 (p.5-6)

45. McKENZIE-GRAY PROSPECT (SHARON, RICHMORE)

LOCATION: South-southwest of Mine Centre between Dumbbell Lake and Shoal Lake. Latitude 48°41.1'N, longitude 92°40.7'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Au, Ag

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by coarse-grained tonalite and minor metagabbro. Metavolcanic xenoliths have been observed in the tonalite. Southwesterly to northwesterly striking shear zones host quartz veins.

MINERALIZATION: The quartz veins contain appreciable amounts of sulphide minerals including pyrite, chalcop-

pyrite and sphalerite. Malachite and calcite were also noted.

SIZE AND GRADE: Two principal systems are exposed on the property.

The Main vein has been thoroughly channel sampled at various times on surface, and the following values have been reported: 0.49 ounce per ton gold over 2.9 feet (0.88 m) for 250 feet (76 m); 0.44 ounce per ton gold, 2.9 ounces of silver per ton over 4.0 feet (1.2 m) for 175 feet (53 m); 0.27 ounce per ton gold over 4.0 feet (1.2 m) for 300 feet (92 m); 0.47 ounce per ton gold over 3.56 feet (1.09 m) for 270 feet (82 m); and 0.49 ounce per ton gold over 4.6 feet (1.4 m) for 182 feet (56 m).

A recent diamond-drill program revealed low gold values with the best reported intersection of 0.08 ounce per ton gold over 2.4 feet (0.73 m) of core.

An earlier shallow diamond-drill program indicated 0.195 ounce per ton gold, 0.71 ounce per ton silver, and 2.11% Zn over 2.36 feet (0.72 m) for a length of 220 feet (67 m).

HISTORY:

1926: Discovery; shallow diamond-drill holes by Bankfield Mines, dates unknown.

1934: Staked by Richmore Syndicate; surface sampling by McIntyre, US Smelters, Ventures Group, Wells Long Lac.

1938: Surface sampling checked by Wright-Hargreaves Limited.

1940: Surface sampling checked by Sylvanite Gold Mines Limited.

1980: Stripping, trenching and diamond drilling (5 holes) by Corporate Oil and Gas Limited.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.29)
- Ferguson, Groen and Haynes 1971 (p.261)
- Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.
- Tanton 1935 (p.12-13)

46. DINOSAUR PROSPECT

LOCATION: About 3.2 km northeast of Shoal Lake. Latitude 48°42.7'N, longitude 92°33.8'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain by intercalated mafic, intermediate and felsic metavolcanic schists. These units strike 240° and have a well-developed, steeply dipping foliation. Locally, the felsic quartz-sericite schists contain abundant chloritoid as 2 to 5 mm grains that overgrow cleavage. The property is thought to lie in a fault-bounded block of metavolcanic rocks bordered to the

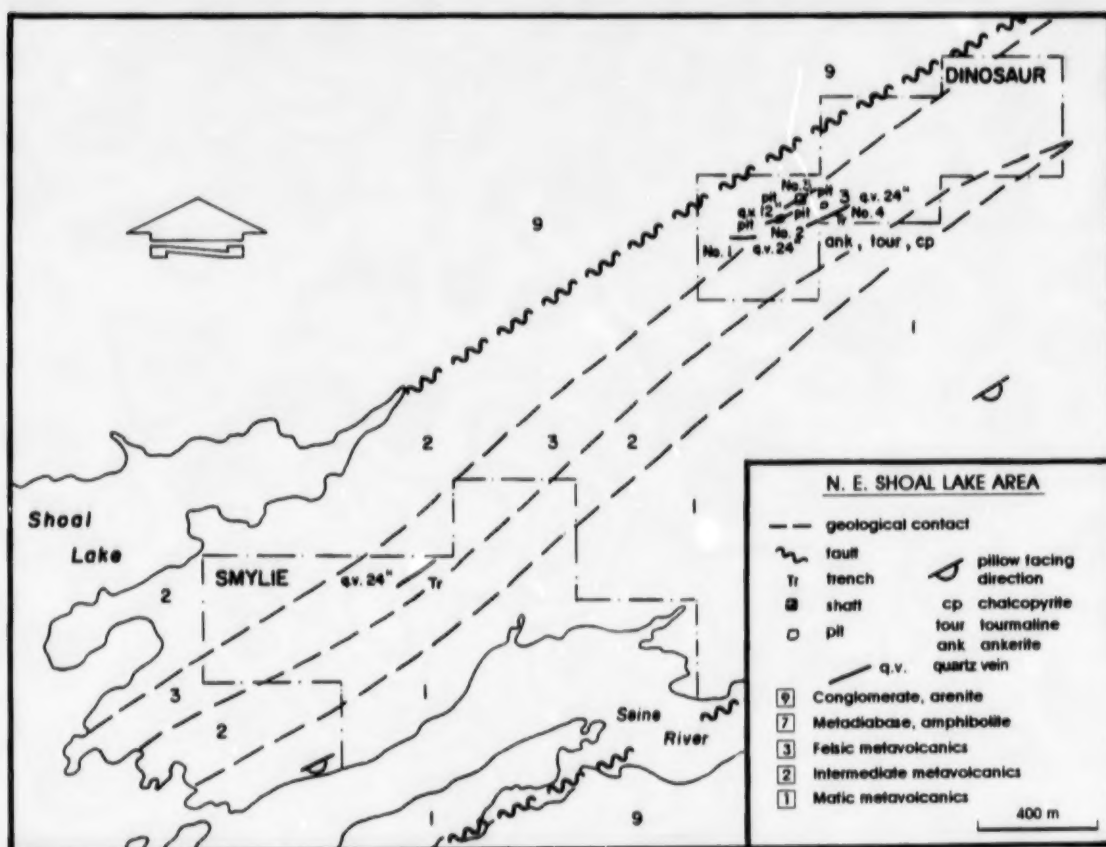


Figure 29. Geology northeast of Shoal Lake (adapted after Wood et al. 1980b with minor new mapping by K.H. Poulsen). Other symbols as in Figure 16.

north and south by conglomerates and arenites of the Seine metasediments (Figure 29).

MINERALIZATION: Gold-bearing quartz veins are hosted by chlorite and chloritoid-sericite schists, which are locally crenulated near the veins. The veins are locally laminated, and quartz is accompanied by chalcopyrite, ankerite and tourmaline. Some veins and stringers parallel pre-existing foliation, while others are oblique to local foliation developed in right-hand shear zones.

SIZE AND GRADE: No assay data are available for these veins, but locally, encouraging values have been reported, particularly in veins oblique to the foliation. The veins strike southwesterly and are approximately vertical. The quartz veins on the Dinosaur property (No. 1 to 4) range from 12 to 24 inches (37 to 73 cm) wide, and silicified zones in the sericite schist are approximately 24 inches (73 cm) wide.

HISTORY:

1895: Part of the Bull Price & Company property.

1936: Trenching and test pits; rehabilitation of trenches.

SELECTED REFERENCES:

Coleman 1896 (p.67-68)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

Tanton 1935 (p.13)

47. LUCKY COON MINE (HILLYER)

LOCATION: South of Highway 11 on Shoal Lake Road. Latitude 48°43.8'N, longitude 92°37.4'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Au, Ag

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: The property is underlain predominantly by tonalite. Conglomerate of the Seine metasediments underlies the southeastern corner of the property. Numerous northwesterly striking shear zones contain-

ing steeply dipping quartz veins transect the property. Both left- and right-hand shear zones have been observed.

MINERALIZATION: Six gold-bearing quartz vein systems have been outlined on the property. The veins contain minor ankerite, pyrite, galena and sphalerite as accessory minerals. Sericitized foliated wall rock is common adjacent to the veins.

SIZE AND GRADE: The veins strike from 290 to 340° and generally dip southwesterly at 80°. They vary in width from 8 inches (20 cm) to 8 feet (2.5 m), and commonly intersect at acute angles. Surface channel sample programs in 1939 have indicated generally low gold values, with narrow ore "shoots" developed near vein intersections and terminations. The southeastern end of the No.1 vein showed 0.31 ounce per ton gold over 1.5 feet (0.46 m) for a length of 71.5 feet (21.8 m). The No.2 vein returned assays of 0.31 ounce per ton gold over 2.4 feet (0.73 m) for a length of 103 feet (32 m) near the No.3 shaft. The No.4 vein assayed 0.13 ounce per ton gold over 2.2 feet (0.67 m) for a length of approximately 20 feet (6 m). The No.5 vein yielded 0.13 ounce per ton gold over 10.5 inches (27 cm) for a length of 60 feet (18.3 m) near the No.5 shaft. Production of 6.47 ounces of gold in 1899, and 10 ounces of gold with 1 ounce of silver in 1935, came from the No.5 shaft.

HISTORY:

1894: Discovery by W. Campbell, A.M. Robertson and J. Mosher. Stripping, shaft sinking and five-stamp mill.

1899: Reopened briefly. By this time No.1 shaft to 65 feet (20 m), No.2 shaft to 108 feet (33 m), No.3 shaft to 30 feet (9.1 m) and No.5 shaft to 78 feet (24 m). Mill run of 3.2 tons from No.5 shaft.

1924: Metallurgical testing of 200-pound bulk samples assaying 2.2 ounces of gold per ton.

1934-36: Surface sampling and limited production from 10 tons; No.5 shaft to 110 feet (34 m).

1937: Sampling by Erie Canadian Mines Limited.

1939-40: Thorough surface sampling, and one 440-foot (134 m) diamond-drill hole by Sylvanite Gold Mines Limited.

1982: Option to Sherritt Gordon Mines Limited.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.25)
- Blue 1896 (p.155-157)
- Bow 1900 (p.70)
- Coleman 1895 (p.57)
- Ferguson, Groen and Haynes 1971 (p.257)
- Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.
- Sinclair 1937 (p.94)
- Tanton 1935 (p.7)

48. MANHATTAN-DECCA MINES

LOCATION: South of Highway 11, on the western side of Shoal Lake Road. Latitude 48°43.6'N, longitude 92°37.7'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

GENERAL GEOLOGY: These properties are underlain dominantly by coarse-grained tonalite. Seine conglomerate likely underlies the drift-covered southeastern corner of the Manhattan property. Westerly to northwesterly striking shear zones cut the tonalite. Both left- and right-hand senses of displacement have been observed. Foliated to locally mylonitic tonalite occurs in the shear zones.

MINERALIZATION: At least 6 quartz vein systems are developed within the shear zones. Minor ankerite, pyrite, sphalerite, chalcopryrite and galena occur locally within the veins. Zones of rose-coloured, finely laminated quartz within larger quartz veins reportedly carry gold. White vitreous quartz is reportedly gold-free. Horses and inclusions of foliated tonalite are common in the veins.

SIZE AND GRADE: Intersecting quartz veins strike between 290 and 360° and dip steeply to the southwest. Individual veins range from a few inches to greater than ten feet (up to 3 m) in width. Within the Manhattan No.3 composite vein, a "pay streak" ranging from 1 to 3 feet (0.3 to 0.9 m) wide reportedly contains 6000 tons grading 0.3 to 0.5 ounce per ton gold. Limited data are available for the remaining veins, but development in the Decca No.1 shaft appears to have followed a 1- to 3-feet-wide (0.3 to 0.9 m) vein carrying appreciable amounts of gold.

HISTORY:

1898: Manhattan (Bush Winning property) shaft sunk to 27 feet (8.2 m); Decca No.1 shaft to 55 feet (17 m), No.2 shaft to 105 feet (32 m).

1899: Manhattan shaft to 170 feet (52 m); Decca No.1 shaft to 210 feet (64 m), No.2 shaft to 110 feet (34 m) and flooded.

1900: Manhattan shaft to 325 feet (99 m), crosscut and drift developed.

1971-74: Trenching and diamond drilling by R.C. Cone, Sr.

1979: Trenching by R.C. Cone, Jr.

1981: 1 diamond-drill hole on Decca, R.C. Cone, Jr.

1982: Stripping and sampling, Sherritt Gordon Mines Limited.

SELECTED REFERENCES:

- Beard and Garratt 1976 (p.14)
- Bow 1899 (p.83)
- Bow 1900 (p.68, 70)
- Bow and Carter 1901 (p.83-84)

49. BLONDEAU-MERRYTH PROSPECT (see also TURTLE TANK PROSPECT, property 14)

LOCATION: Straddling Highway 11, east of Mine Centre. Latitude 48°45.4'N, longitude 92°34.9'W.

Map reference: NTS 52 C/15SE

COMMODITY: Cu

CLASSIFICATION: Types 3A, 1B

GENERAL GEOLOGY: The property is underlain by intensely foliated mafic to felsic metavolcanic rocks that have been intruded by quartz porphyry masses and sills of metadiabase. Conglomerate and arenite of the Seine meta-sediments underlies the southeastern part of the property. Foliation strikes 265° and dips 75° north. Foliated rocks commonly contain abundant ankerite, and rhyolitic rocks exposed in the northern part of the property are very sericitic.

MINERALIZATION: Chalcopyrite and pyrite are common constituents as disseminations in foliated metavolcanic rocks and metadiabase. Minor quartz-ankerite veins also contain sulphide minerals, and abundant chalcopyrite and minor gold are present in the Turtle Tank prospect.

SIZE AND GRADE: Diamond-drill holes testing geochemical anomalies in the north-central part of the property encountered minor sulphide mineralization associated with silicification. Assays of 0.12% Cu, 0.03% Zn over 1.7 m were reported from a single intersection (Resident Geologist's files, Ministry of Northern Development and Mines, Kenora). Copper and gold values have also been reported from the Turtle Tank prospect, which was incorporated into this claim group.

HISTORY:

1917: Test pit by International Copper Mining Company.

1970: Geological mapping, magnetic, electromagnetic and soil geochemical surveys, trenching and 4 diamond-drill holes by Northgate Exploration Limited.

SELECTED REFERENCES:

Parsons 1918 (p.176)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

50. HANNA PROSPECT (see also PIDGEON PROSPECT (property 51), ALICE "A" MINE (property 13))

LOCATION: East of Mine Centre near Highway 11. Latitude 48°45'N, longitude 92°30'W.

Map reference: NTS 52 C/10NE, /5SE, /6SW

COMMODITY: Zn

CLASSIFICATION: Type 1A

GENERAL GEOLOGY: Rhyolitic tuff and lapilli tuff are the dominant rock types exposed on this property. They are intercalated with minor metavolcanic rocks of intermediate composition, and are cut by narrow sills of metadiabase. The rocks are intensely foliated, and all rock units are increasingly transposed into an easterly orientation in proximity to the Quetico Fault at the northern margin of the property.

MINERALIZATION: Gold-bearing quartz veins (see Alice "A" Mine, assorted occurrences) are located within the bounds of this property. Base metal exploration within the potentially attractive felsic metavolcanic rocks revealed only disseminated pyritic mineralization.

SIZE AND GRADE: Disseminated sulphide mineralization grading 0.03% Zn over 22 feet (6.7 m) was intersected in 1 diamond-drill hole in the north-central part of the property.

HISTORY:

1975-76: Electromagnetic and magnetic surveys, geological mapping and 2 diamond-drill holes by Hanna Mines.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

51. PIDGEON PROSPECT (see also HANNA PROSPECT, property 50)

LOCATION: East of Mine Centre on Highway 11. Latitude 48°44.5'N, longitude 92°53'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Zn, Pb

CLASSIFICATION: Type 1A

GENERAL GEOLOGY: The property is underlain by intercalated intermediate to felsic tuff and minor lapilli tuff. The units strike northeastward, and pillows in conformable units to the east (Figure 30) suggest a southeastward facing. A steeply dipping regional foliation striking 70° northeast is well developed in the area.

MINERALIZATION: Sphalerite and galena mineralization is exposed principally at 2 locations along the top of an altered sequence of felsic tuffs on patented claims P683 and K301 (see Figure 30). The mineralization occurs as massive lenses with some ankerite in silicified rhyolite. Spotted pyrite alteration is ubiquitous in the footwall to the mineralization, and is exposed over a strike length of 2.5 km. The alteration appears to increase in intensity toward the mineralized horizon, and is accompanied by sericitization and silicification of the host rocks.

SIZE AND GRADE: All available assay data (Table 7) comes from drill holes on the southwestern claim group

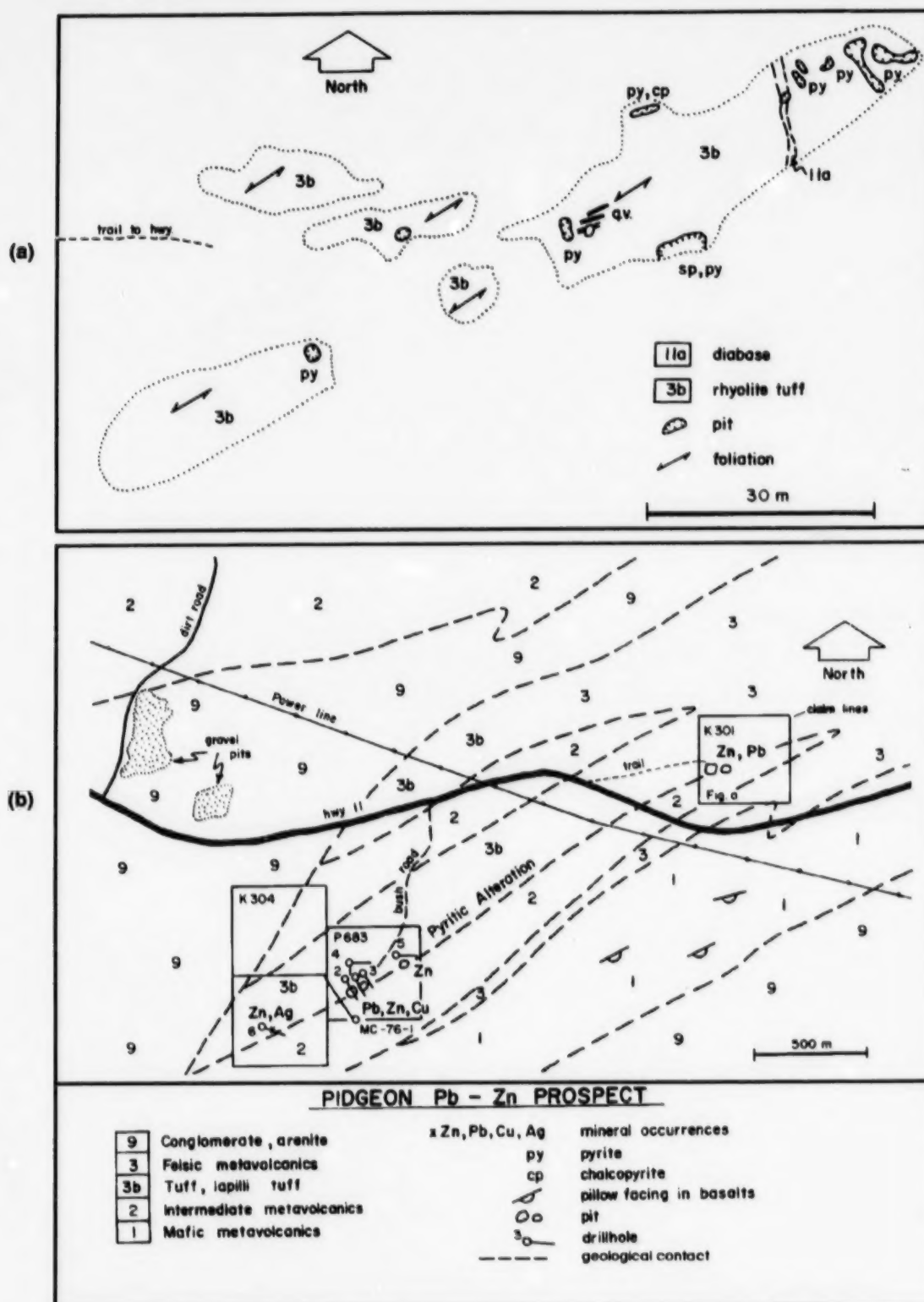


Figure 30. Geology of the Pidgeon property (*adapted from Wood et al. 1980b with local new mapping by K.H. Poulsen and G. Laws in 1981*). Other symbols as in Figure 16.

Table 7. Assay data from drill holes on the southwestern claim group of the Pidgeon prospect.

ddh	depth (ft)	width (ft)	Zn %	Pb %	Ag (oz/ton)	Cu %
1	15	10.0	0.53	1.76		
	37.5	5.0	-	1.08		
2	38	0.5	5.61	-	0.32	n.d.
	7	2.0	2.10	0.18	0.16	n.d.
4	100	2.0	0.5	0.03	0.12	n.d.
6	8	8.0	0.87	-	0.36	n.d.
	98	10.5	1.0	-	0.03	n.d.
mc-76-1	300	2.5	0.83	n.d.	0.04	0.06
	515	3.5	0.7	n.d.	0.19	0.04
	560	12.0	0.44	n.d.	0.05	0.03
	775	50.0	0.15	n.d.	n.d.	n.d.

n.d. = not determined

(Resident Geologist's files, Ministry of Northern Development and Mines, Kenora).

HISTORY:

1969: 6 diamond-drill holes (672 feet; 205 m) by Kerr Addison Mines.

1976: Electromagnetic, magnetic and geological surveys plus 1 diamond-drill hole (800 feet; 244 m) by Hanna Mines.

SELECTED REFERENCES:

Poulsen 1981

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

52. SHOAL LAKE IRON OCCURRENCE

LOCATION: South of Seine River. Latitude 48°40.8'N, longitude 92°33.5'W.

Map reference: NTS 52 C/10NE

COMMODITY: Fe

CLASSIFICATION: Type 1D

DESCRIPTION: Laminated iron formation composed of magnetite laminae in a biotitic metasedimentary host occupies an 8 km long, southwesterly striking zone adjacent to the Rainy Lake-Seine River fault. Although metavolcanic rocks are nearby, this iron formation differs from those in the western part of the map area by the absence of chert and sulphide mineralization. The zone was tested with 4 diamond-drill holes totalling 2423 feet (739 m) by W. Meakin.

SELECTED REFERENCES:

Shklanka 1968 (p.310)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

53. EMMA ABBOT OCCURRENCE

LOCATION: East of Glenorchy. Latitude 48°46.2'N, longitude 92°27.9'W.

Map reference: NTS 52 C/16SW

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: Test pits were developed on quartz veins up to 2 feet (0.6 m) wide in felsic metavolcanic rocks. Galena, chalcopryrite, pyrite and visible gold have been reported (see Alice "A" Mine, property 13).

SELECTED REFERENCE:

Bow 1900 (p.75)

54. GOLD BUG OCCURRENCE

LOCATION: West of Alice "A" Mine (property 13), east of Glenorchy. Latitude 48°46.2'N, longitude 92°28.9'W.

Map reference: NTS 52 C/16SW

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: Quartz stringers are hosted by foliated felsic metavolcanic rocks. Galena, chalcopryrite, pyrite and gold have been reported.

SELECTED REFERENCE:

Bow 1900 (p.75)

55. EAST TURTLE RIVER OCCURRENCE

LOCATION: Northeast of Mine Centre. Latitude 48°46.4'N, longitude 92°31.6'W.

Map reference: NTS 52 C/15SE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A test pit has been established on an *en échelon* set of foliation-parallel quartz veins in metamor-

phosed rhyolite. The veins are vertical, strike 270° and contain abundant pyrite.

SELECTED REFERENCE:

Wood et al. 1980a, 1980b

56. WEST TURTLE RIVER OCCURRENCE

LOCATION: Northeast of Mine Centre. Latitude 48°46.4'N, longitude 92°31.6'W.

Map reference: NTS 52 C/15SE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A shallow shaft has been sunk on narrow quartz veins in locally folded phyllitic metavolcanic rocks. The veins strike 270° and contain ankerite and pyrite.

57. TURTLE SIDING OCCURRENCE

LOCATION: North of Turtle station, along the Canadian National Railway line. Latitude 48°46.0'N, longitude 92°33'W.

Map reference: NTS 52 C/15SE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A shaft has been sunk on an irregular system of quartz-pyrite-ankerite veins. The veins occupy a steep zone striking 260° in schistose metarhyolite. Veins parallel the foliation and some occupy steeply plunging drag folds.

58. McMILLAN OCCURRENCE

LOCATION: West of Mine Centre. Latitude 48°46.1'N, longitude 92°38.1'W.

Map reference: NTS 52 C/15SE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A trench has been developed on an *en échelon* set of quartz-ankerite stringers that parallel foliation in chlorite schists. The zone is up to 10 feet (3 m) wide and strikes 270°.

59. HICKERSON OCCURRENCE

LOCATION: Near power line, southwest of Mine Centre. Latitude 48°45.8'N, longitude 92°37.7'W.

Map reference: NTS 52 C/15SE

COMMODITY: Cu

CLASSIFICATION: Type 1B

DESCRIPTION: A pit has been developed in intermediate metavolcanic tuffs containing pyritic stringers and traces of chalcoppyrite. Adjacent rocks are locally amygdaloidal, and scattered ankeritic alteration occurs to the north.

60. EMPEROR MINE

LOCATION: South of Mine Centre, east of Bad Vermilion Lake. Latitude 48°43.8'N, longitude 92°37.9'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A shaft, 125 feet (38 m) deep, was sunk in 1898 on a northwesterly striking quartz vein in tonalite. The vein averaged 6 inches (15 cm) wide and was traced for 1200 feet (366 m) along strike. This property was not examined by the author.

SELECTED REFERENCE:

Bow 1900 (p.83)

61. GIBSON OCCURRENCE

LOCATION: West of Foley Mine (property 2), northwest of Shoal Lake. Latitude 48°41.9'N, longitude 92°39.1'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A series of northerly striking quartz veins are hosted by shear zones in tonalite. Five veins reportedly carry gold, and a few tons of ore were extracted from open cuts in 1933.

SELECTED REFERENCE:

Tanton 1935 (p.12)

62. SMYLLIE OCCURRENCE

LOCATION: On the eastern shore of Shoal Lake. Latitude 48°42.2'N, longitude 92°34.1'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A southeastward-facing sequence of intercalated felsic to mafic metavolcanic rocks underlie the property. The felsic rocks have been metamorphosed to chloritoid-bearing quartz-sericite schists, and a steep cleavage striking 240° is present in most outcrops. Quartz veins and silicified zones in the sericite schist have been traced for a strike length of 400 feet (122 m) via trenching and 5 diamond-drill holes (1937). Visible gold has been reported from one of these veins, which ranges up to 24 inches (61 cm) wide (see Figure 29).

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

63. ISLAND BAY COPPER OCCURRENCES

LOCATION: Between Island Bay and Finger Lake, Bad Vermilion Lake area. Latitude 48°42.9'N, longitude 92°39.5'W.

Map reference: NTS 52 C/10NE

COMMODITY: Cu

CLASSIFICATION: Type 2A

DESCRIPTION: Trenches and an open cut at the southern end of Island Bay have exposed chalcopryite, pyrrhotite and pyrite mineralization. The sulphide minerals occur as fine disseminations and fracture fillings in foliated, locally mylonitic anorthosite. A small amount of copper ore was reportedly shipped from the open cut during World War I.

SELECTED REFERENCES:

- Parsons 1918 (p.174)
- Shklanka 1969 (p.225)
- Wood et al. 1980a

64. STONE OCCURRENCE

LOCATION: Northwest of Bad Vermilion Lake. Latitude 48°40.4'N, longitude 92°30.1'W.

Map reference: NTS 52 C/15SE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: Several mineralized quartz veins are reported in shear zones in trondhjemite and intermediate metavolcanic rocks. This property was not examined by the author.

SELECTED REFERENCES:

- Hawley 1930a (p.56)
- Tanton 1935 (p.5)

65. AMALGAMATED RARE EARTHS OCCURRENCE

LOCATION: Northwestern shore of Bad Vermilion Lake. Latitude 48°38.3'N, longitude 92°30.4'W.

Map reference: NTS 52 C/15SE

COMMODITY: Cu

CLASSIFICATION: Type 2A

DESCRIPTION: In 1963 a 161-foot (49 m) diamond-drill hole intersected minor chalcopryite. Host rocks are meta-

gabbro with local shear zones containing intensely foliated chlorite schist.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

66. CORRIGAN OCCURRENCE

LOCATION: West of Mine Centre. Latitude 48°45.9'N, longitude 92°39.0'W.

Map reference: NTS 52 C/15SE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A quartz vein in felsic tuff is exposed in a pit. The vein is 50 feet (15 m) long, and a 43-inch (109 cm) channel sample reportedly yielded gold, silver, lead and zinc values. This property was not examined by the author.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

67. MATHIEU OCCURRENCE

LOCATION: West of Mine Centre, north of Highway 11. Latitude 48°45.9'N, longitude 92°40.1'W.

Map reference: NTS 52 C/15SE

COMMODITY: Cu, Zn

CLASSIFICATION: Type 1B

DESCRIPTION: During the winter of 1917 two test shafts were sunk on mineralization in amygdaloidal schist north-east of the Port Arthur Copper Co. Mine. The shafts were located again in 1982 by R. Pitkanen who then undertook limited stripping in their vicinity. Chalcopryite, sphalerite and pyrite occur in seams within the highly chloritic schist, which possesses a strong, steep east-trending foliation.

SELECTED REFERENCE:

- Parsons 1918 (p.173-174)

68. THOMPSON OCCURRENCE

LOCATION: South of Highway 11, southwest of Mine Centre. Latitude 48°44.8'N, longitude 92°43.0'W.

Map reference: NTS 52 C/10NE

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: Trenching by Ed-Vic Explorations Limited in 1979 exposed a southwesterly striking zone of extensional quartz-ankerite veins. Individual veins strike 310° and contain local pyrite. Four grab samples reportedly averaged 0.08 ounce per ton gold. The host is coarse xenolithic trondhjemite, which contains abundant carbonate

and pyrite adjacent to the veins. Chloritic vein and breccia alteration in nearby fine-grained felsic rocks is likely related to base metal mineralization on the Port Arthur Copper Co. Mine horizon to the northeast.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

69. ANOMALY 44A OCCURRENCE (NORANDA BARBER LAKE PROPERTY)

LOCATION: East of Barber Lake. Latitude 48°44.4'N, longitude 92°44.6'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Cu, Zn, Pb

CLASSIFICATION: Type 1B

DESCRIPTION: In 1969 and 1970, Noranda Mines Limited drilled 3 holes totalling 1134 feet (346 m) into mineralized amygdaloidal chlorite schist. These rocks are overlain by spherulitic rhyolite to the north and are cut by dikes of metadiabase. Two zones, 150 feet (46 m) apart, containing pyrite and pyrrhotite with sphalerite, chalcopyrite and traces of galena, were intersected in one drill hole. These zones graded 0.49% Zn, 0.07% Cu and 0.06% Pb over 15 feet (4.6 m), and 0.45% Zn, 0.1% Cu and 0.06% Pb over 17 feet (5.2 m).

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

70. BARBER LAKE BASE METAL OCCURRENCE (ARMSTRONG-HODGE PROPERTY)

LOCATION: South of Highway 11, west of Barber Lake. Latitude 48°44.6'N, longitude 92°44.6'W.

Map reference: NTS 52 C/10NE

COMMODITIES: Cu, Zn, Pb

CLASSIFICATION: Type 1B

DESCRIPTION: Amygdaloidal chlorite schist is overlain to the north by spherulitic rhyolite. In 1973, J. Hodge and G. Armstrong drilled 3 holes to test an electromagnetic conductor. A 12.5-foot (3.8 m) length of core returned assays averaging 2.06% Zn, 0.11% Cu, 0.01% Pb, 0.14 ounce per ton silver and nil gold.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

71. BARBER LAKE GOLD OCCURRENCE (HUBER & ASSOCIATES)

LOCATION: Southeast of Barber Lake. Latitude 48°43.4'N, longitude 92°46.1'W.

Map reference: NTS 52 C/10NW

COMMODITIES: Au, Cu

CLASSIFICATION: Type 3A

DESCRIPTION: A series of pits and trenches was established by Ed-Vic Explorations Limited in 1977 on northwesterly striking quartz veins near the contact between the intermediate flows and the felsic tuffs to the northwest. The veins contain pyrite and chalcopyrite, and an assay of 1.18 ounces of gold per ton was reported for a sample from a 12-inch-wide (31 cm) vein at the southern end of the property.

SELECTED REFERENCE:

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

72. SCOTT ISLAND OCCURRENCE

LOCATION: Scott Island, Seine Bay. Latitude 48°38.9'N, longitude 92°55.0'W.

Map reference: NTS 52 C/10NW

COMMODITY: Au

CLASSIFICATION: Type 3A

DESCRIPTION: A shallow shaft sunk on Scott Island in the 1890s reportedly yielded material assaying up to 0.3 ounce per ton gold. Lenticular quartz veins on the southwestern shore of the island occur within shear zones in metagabbro, but grab samples of this material contained no gold. Veins strike 240°, are steeply dipping, range up to 12 inches (31 cm) wide and contain moderate amounts of pyrite and chalcopyrite.

SELECTED REFERENCE:

Coleman 1897 (p.83)

73. SWELL BAY OCCURRENCE

LOCATION: On a small island on the northern shore of Swell Bay. Latitude 48°41.9'N, longitude 92°57.8'W.

Map reference: NTS 52 C/10NW

COMMODITIES: Au, Cu, Ag

CLASSIFICATION: Type 3A

DESCRIPTION: An irregular, northwesterly striking quartz vein cuts pillowed metabasalt. Chalcopyrite and pyrite are abundant in the vein, and a grab sample from a small trench yielded 3.45% Cu, 0.11 ounce per ton gold and 0.65 ounce per ton silver (Harris 1974).

SELECTED REFERENCE:

Harris 1974 (p.84)

74. TUNNEL BAY OCCURRENCE

LOCATION: On the Canadian National Railway line, south of Redgut Bay. Latitude 48°42.6'N, longitude 92°58.9'W.

Map reference: NTS 52 C/10NW

COMMODITY: Mo

CLASSIFICATION: Type 3B

DESCRIPTION: Outcrops expose garnetiferous metasedimentary biotite schist cut locally by narrow granodiorite dikes. Quartz veins and stockwork cut both the granodiorite dikes and the biotite schist. Molybdenite and pyrite occur within the veins, as fracture fillings and as disseminations in the wall rocks. Pyrite is particularly enriched in wall rocks adjacent to the veins, some of which contain garnet, biotite and/or muscovite.

SELECTED REFERENCE:

Harris 1974 (p.83)

75. MOOSE POINT OCCURRENCE (ARMSTRONG)

LOCATION: On the eastern side of Redgut Bay. Latitude 48°44.8'N, longitude 92°57.4'W.

Map reference: NTS 52 C/10NW

COMMODITIES: Fe, Cu

CLASSIFICATION: Type 1D

DESCRIPTION: Two diamond-drill holes in 1981 tested a long, northeasterly striking electromagnetic conductor which parallels the eastern shore of Redgut Bay. The area is underlain by intercalated granitic gneiss, amphibolite and biotitic migmatite. The conductor represents a steeply dipping formational unit composed of metamorphosed magnetite-rich iron formation with minor sulphidic and locally graphitic shale units.

76. BEAR PASS IRON OCCURRENCE

LOCATION: On the Canadian National Railway line near drawbridge. Latitude 48°42.4'N, longitude 93°01.5'W.

Map reference: NTS 52 C/11NE

COMMODITY: Fe

CLASSIFICATION: Type 2C

DESCRIPTION: Early reports indicated iron occurrences in this area. No development is known but outcrop examination indicates local magnetite disseminations associated with gabbro of the Grassy Portage intrusion.

SELECTED REFERENCE:

Shklanka 1968 (p.298)

77. DRAWBRIDGE OCCURRENCES

LOCATION: Western shore of Redgut Bay. Latitude 48°43.3'N, longitude 93°00.8'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Types 2A, 2B

DESCRIPTION: Disseminated pyrrhotite-pyrite mineralization with minor chalcopyrite occurs in the upper zone of the Grassy Portage intrusion. Mineralization is spatially related to blocks of siliceous metasedimentary rocks that are incorporated into the roof zone of the intrusion. The mineralization has been tested by a single diamond-drill hole by Noranda Mines Limited in 1967, and by trenching and stripping by L.E. Cousineau in 1975-76. No grades are available.

78. HIGHWAY 11 MOLYBDENUM OCCURRENCE

LOCATION: 100 m west of the intersection of Highway 11 and Highway 502. Latitude 48°43.1'N, longitude 93°02.7'W.

Map reference: NTS 52 C/11NE

COMMODITY: Mo

CLASSIFICATION: Type 3B

DESCRIPTION: Host rocks include a folded sequence of leucocratic sills that intrude biotite schist, iron formation and metavolcanic rocks. The structures plunge gently eastward. Molybdenite, with minor pyrite, occurs as fracture fillings and disseminations within the leucocratic granitoid intrusions, and as disseminations in quartz veins that cut the intrusions. Bleached alteration selvages envelope some veins. No grades are available.

SELECTED REFERENCE:

Harris 1974 (p.85)

79. RICE BAY OCCURRENCES

LOCATION: Northern and western shores of Rice Bay. Latitude 48°44.7'N, longitude 93°05.7'W.

Map reference: NTS 52 C/11NE

COMMODITY: Fe

CLASSIFICATION: Type 1D

DESCRIPTION: Trenches of unknown origin expose lean iron formation. Garnet-biotite-magnetite schist is intercalated with felsic to intermediate composition metavolcanic rocks that are intensely foliated. Although up to 5% sulphide minerals are present, only traces of copper and nickel have been reported (Harris 1974).

SELECTED REFERENCE:

Harris 1974 (p.76 and p.85)

80. COOPER-WEISS OCCURRENCE

LOCATION: On the Canadian National Railway line east of Nickel Lake, Watten Township. Latitude 48°42.1'N, longitude 93°05.5'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Type 1D

DESCRIPTION: Small amounts of pyrite, pyrrhotite and traces of chalcopryite are associated with the contact between metadiabase and chloritic metasedimentary rocks associated with lean iron formation. The zone is located near the hinge of the Nickel Lake synform (see Figure 23) and was tested by a single diamond-drill hole in 1966. No values are reported.

SELECTED REFERENCE:

Harris 1974 (p.83-84)

81. WALLACE OCCURRENCE (MORRISON CLAIMS)

LOCATION: On the Canadian National Railway line west of Nickel Lake, Watten Township. Latitude 48°41.4'N, longitude 93°07.4'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Fe, S

CLASSIFICATION: Type 1D

DESCRIPTION: The property occurs on the southern limb of the Nickel Lake synform and covers the southwestward extension of the main iron formation of the Nickel Lake prospect (see Figure 23). Chert-magnetite iron formation strikes northeast across the property, and narrow (0.3 m) layers in the iron formation contain disseminated to locally massive pyrite. A test sample of pyrite was extracted from a pit (see Figure 23) in 1918.

SELECTED REFERENCES:

Harris 1974 (p.60)

Hewitt 1967 (p.46)

Robinson 1920 (p.17)

82. MOOSEHORN OCCURRENCE

LOCATION: Northwest of Nickel Lake, Watten Township. Latitude 48°42.2'N, longitude 93°08.6'W.

Map reference: NTS 52 C/11NE

COMMODITY: Zn

CLASSIFICATION: Type 1C

DESCRIPTION: In 1969, Noranda Mines Limited followed up 2 geophysical anomalies on the northern limb of the Nickel Lake synform (see Figure 23). Pyrite, pyrrhotite

and minor sphalerite are hosted by sulphide iron formation in a sequence consisting of pillowed metabasalt, metadiabase and minor metasedimentary rocks. A diamond-drill hole testing the westward extension of the Daley-Galbraith main zone encountered moderate amounts of pyrrhotite and pyrite. A second hole, 1 km to the southwest, encountered some sphalerite with iron sulphide minerals in black shale on a different stratigraphic horizon. Assays of 0.55% Zn over 2.7 m were reported from this hole.

SELECTED REFERENCES:

Harris 1974 (p.60)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

83. KOTNICK OCCURRENCE

LOCATION: West of Nickel Lake, Watten Township. Latitude 48°41.8'N, longitude 93°09.4'W.

Map reference: NTS 52 C/11NE

COMMODITIES: Fe, Cu

CLASSIFICATION: Type 1D

DESCRIPTION: Sulphide facies iron formation occurs in deformed pillowed metabasalt at the core of the Nickel Lake synform. Trenches were established in sedimentary units that contain laminated pyrrhotite with pyrite and traces of chalcopryite. Three zones, striking 70°, are located 150 m and 480 m north, and 100 m south, of Highway 11.

SELECTED REFERENCE:

Harris 1974 (p.56-57)

84. REEF POINT OCCURRENCE

LOCATION: Near the tip of Reef Point, Watten Township. Latitude 48°41.9'N, longitude 93°16.6'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Type 1D

DESCRIPTION: Three diamond-drill holes and a trench tested pyrrhotite-pyrite mineralization in a steeply dipping zone bounded by pillowed metabasalt. The sulphide mineralization is disseminated to massive and, locally, chalcopryite occurs in fractures. Harris (1974) reported 0.09% Cu from a representative sample of this material. The zone averages approximately 3 m wide.

SELECTED REFERENCE:

Harris 1974 (p.76-77)

85. CROOME OCCURRENCE

LOCATION: Northwestern side of Reef Point, Watten Township. Latitude 48°42.0'N, longitude 93°16.1'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Type 1D

DESCRIPTION: Intensely foliated metavolcanic and metasedimentary schists host narrow zones of massive pyrrhotite with local coarse pyrite, minor chalcopyrite and sphalerite. Immediate host rocks are silicified metasedimentary rocks, possibly recrystallized chert. The zone is up to 3 m wide and has been tested by a single diamond-drill hole.

SELECTED REFERENCES:

Harris 1974 (p.48)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

86. MILLER'S BAY OCCURRENCE

LOCATION: Along the southern side of Reef Point, Watten Township. Latitude 48°41.7'N, longitude 93°16.0'W.

Map reference: NTS 52 C/11NE

COMMODITY: Cu

CLASSIFICATION: Type 1D

DESCRIPTION: Disseminated pyrrhotite with minor pyrite, chalcopyrite and magnetite occur in a stratiform zone up to 7 m wide in biotite schist. A representative grab sample from the steeply dipping zone yielded 0.34% Cu (Harris 1974). Three short diamond-drill holes tested this zone in 1955.

SELECTED REFERENCES:

Harris 1974 (p.84)

Resident Geologist's files, Ministry of Northern Development and Mines, Kenora.

87. HOPKINS BAY OCCURRENCE

LOCATION: Between Rocky Islet Bay and Hopkins Bay. Latitude 48°43.4'N, longitude 93°10.7'W.

Map reference: NTS 52 C/11NE

COMMODITY: Mo

CLASSIFICATION: Type 3B

DESCRIPTION: Quartz stringers in rusty equigranular granite contain minor disseminated pyrite and molybdenite. The mineralization occurs at the contact of a quartz monzonitic intrusion with intensely foliated conglomerate. Small pits were developed in 1967 by prospectors working for Noranda Mines Limited. No estimates of grade are available.

SELECTED REFERENCE:

Harris 1974 (p.71)

88. OTTER BAY OCCURRENCE

LOCATION: Mainville Lake area. Latitude 48°48.0'N, longitude 93°09.5'W.

Map reference: NTS 52 C/14SE

COMMODITIES: Mo, U

CLASSIFICATION: Type 3B

DESCRIPTION: Low grades of U_3O_8 were reported from a radioactive pegmatite dike near Otter Bay in 1957. Coarse-grained molybdenite occurs in a similar pegmatite 4 km to the southwest. The property was not examined by the author.

SELECTED REFERENCES:

Blackburn 1973 (p.37)

Robertson 1968 (p.64)

89. PARRY STRAIT OCCURRENCE

LOCATION: 2.3 km north of Farrington station. Latitude 48°47.2'N, longitude 92°50.2'W.

Map reference: NTS 52 C/15SW

COMMODITY: Cu

CLASSIFICATION: Type 1D

DESCRIPTION: A short diamond-drill hole in 1976 by INCO Limited encountered oxide and graphitic sulphide facies of iron formation intercalated with metagabbro and amphibolite. Pyrrhotite, pyrite and minor chalcopyrite were noted. The iron formation was exposed on adjacent ground by trenching in 1972 by J. Kelly and M. Hupchuk. This property was not examined by the author.

References

- Anglin, C.D. 1982. Stratigraphy, petrology and metamorphism of Archean Algoma type iron formation in the Fort Frances area, northwestern Ontario; unpublished BSc thesis, Queen's University, Kingston, Ontario, 87p.
- Ayres, L.D. 1978. Metamorphism in the Superior Province of northwestern Ontario and its relationship to crustal development; in *Metamorphism in the Canadian Shield*, Geological Survey of Canada, Paper 78-10, p.25-36.
- Beard, R.C. and Garratt, G.L. 1976. Gold deposits of the Kenora-Fort Frances area, districts of Kenora and Rainy River; Ontario Division of Mines, Mineral Deposits Circular 16, 46p.
- Bergmann, H.J. 1973. Appraisal report on the property of North Rock Explorations Ltd., Halkirk and Watten townships, Fort Frances Mining Division, Ontario; Kenora Resident Geologist's office, assessment file 52 C/11NE W-2, 21p.
- Birk, D. 1979. Rb/Sr chronology of the Rainy Lake Archean granitoid batholith, Wabigoon belt, northwestern Ontario; *Canadian Journal of Earth Sciences*, v.16, p.141-149.
- Birk, D. and McNutt, R.H. 1981. Geochronology of Wabigoon belt granitoids, northwestern Ontario: Rb/Sr isochrons for seven late-tectonic plutons; *Canadian Journal of Earth Sciences*, v.18, p.157-175.
- Blackburn, C.E. 1973. Geology of the Otukamamoan Lake area, districts of Rainy River and Kenora; Ontario Division of Mines, Geological Report 109, 42p.
- 1977. Kenora-Fort Frances area; Ontario Geological Survey, Map 2443, scale 1:253440.
- Blue, A. 1896. A tour of inspection in northwestern Ontario; Ontario Bureau of Mines, Annual Report, 1895, v.5, p.107-190.
- 1897. General introduction; Ontario Bureau of Mines, Annual Report, 1896, v.6, p.7-70.
- Bow, J.A. 1898. Mines of northwestern Ontario; Ontario Bureau of Mines, Annual Report, 1897, v.7, pt.1, p.35-84.
- 1899. Mines of northwestern Ontario; Ontario Bureau of Mines, Annual Report, 1898, v.8, pt.1, p.49-99.
- 1900. Mines of northwestern Ontario; Ontario Bureau of Mines, Annual Report, 1899, v.9, p.35-88.
- Bow, J.A. and Carter, W.E.H. 1901. Mines of northwest Ontario; Ontario Bureau of Mines, Annual Report, 1900, v.10, p.69-112.
- Bruce, E.L. 1925. Gold deposits of Kenora and Rainy River districts; Ontario Department of Mines, Annual Report, 1925, v.34, pt.6, p.1-42.
- Carter, W.E.H. 1902. The mines of Ontario; Ontario Bureau of Mines, Annual Report, 1901, v.11, p.231-298.
- Coleman, A.P. 1895. Gold in Ontario: its associated rocks and minerals; Ontario Bureau of Mines, Annual Report, 1894, v.4, p.35-100.
- 1896. Second report on the gold fields of western Ontario; Ontario Bureau of Mines, Annual Report, 1895, v.5, p.47-106.
- 1897. Third report on the west Ontario gold region; Ontario Bureau of Mines, Annual Report, 1896, v.6, p.71-124.
- 1898. Fourth report on the west Ontario gold region; Ontario Bureau of Mines, Annual Report, 1897, v.7, pt.2, p.109-145.
- 1902. Iron ranges of northwestern Ontario; Ontario Bureau of Mines, Annual Report, 1901, v.11, p.128-151.
- Davies, J.C. 1977. Geological report of the Armstrong-McTavish claims, Nickel Lake area, Watten Township; Kenora Resident Geologist's office, assessment file 52 C/11NE LL-1, 7p.
- Davis, D.W., Blackburn, C.E., Trowell, N.F. and Edwards, G.R. 1980. Geochronology of the Savant-Crow Lakes area, western Wabigoon Subprovince, districts of Kenora, Rainy River, and Thunder Bay; in *Summary of Geochronology Studies 1977-1979*, Ontario Geological Survey, Miscellaneous Paper 92, p.24-33.
- De Kalb, C. 1899. The condition of Ontario mines; Ontario Bureau of Mines, Annual Report, 1898, v.8, pt.1, p.29-48.
- Ferguson, S.A., Groen, H.A. and Haynes, R. 1971. Gold deposits of Ontario: part 1, districts of Algoma, Cochrane, Kenora, Rainy River, and Thunder Bay; Ontario Division of Mines, Mineral Resources Circular 13, 315p. (reprinted 1973).
- Frye, J.K. 1959. Petrography of the ancient granites of the Minnesota-Ontario boundary region; unpublished MSc thesis, University of Minnesota, Minneapolis, Minnesota, 55p.
- Goldich, S.S. and Peterman, Z.E. 1980. Geology and geochemistry of the Rainy Lake area; *Precambrian Research*, v.11, p.307-337.
- Grout, F.F., Gruner, J.W., Schwartz, G.M. and Thiel, G.A. 1951. Precambrian stratigraphy of Minnesota; *Geological Society of America, Bulletin*, v.62, no.9, p.1017-1078.
- Harris, R.R. 1974. Geology of the Rainy Lake area, District of Rainy River; Ontario Division of Mines, Geological Report 115, 94p.
- Hart, S.R. and Davis, G.L. 1969. Zircon U-Pb and whole-rock Rb-Sr ages and early crustal development near Rainy Lake, Ontario; *Geological Society of America, Bulletin*, v.80, no.4, p.595-616.
- Hawley, J.E. 1930a. Geology of the Sapawe Lake area with notes on some iron and gold deposits of Rainy River District; Ontario Department of Mines, Annual Report, 1929, v.38, pt.6, p.1-58.
- 1930b. "Seine" or "Coutchiching"; *Journal of Geology*, v.38, p.521-547.
- Hewitt, D.F. 1967. Pyrite deposits of Ontario; Ontario Department of Mines, Mineral Resources Circular 5, 64p.
- Hodgson, C.J. 1959. The Watten-Halkirk copper prospect, Rainy Lake area, western Ontario; unpublished MSc thesis, McGill University, Montréal, Québec, 94p.
- Holdaway, M.J. 1971. Stability of andalusite and the aluminum silicate phase diagram; *American Journal of Science*, v.271, p.97-131.
- Hopkins, P.E. 1922. Ontario gold deposits, their character, distribution and productiveness; Ontario Department of Mines, Annual Report, 1921, v.30, pt.2, p.1-73.
- Jolliffe, A.W. 1955. Geology and iron ores of Steep Rock Lake; *Economic Geology*, v.50, p.373-398.
- Lawson, A.C. 1913. The Archean geology of Rainy Lake re-studied; *Geological Survey of Canada, Memoir* 40, 111p.
- Lister, G.F. 1966. The composition and origin of selected iron-titanium deposits; *Economic Geology*, v.61, p.275-310.
- Longstaffe, F.J. and Birk, D. 1981. Oxygen isotope evidence for the origin of discrete granitoid plutons from the Archean western Wabigoon belt, northwestern Ontario; *Precambrian Research*, v.14, p.21-30.
- Merritt, P.L. 1934. Seine-Coutchiching problem; *Geological Society of America, Bulletin*, v.45, p.333-374.
- Ojakangas, R.W. 1972. Rainy Lake area; in *Geology of Minnesota: A Centennial Volume*, Minnesota Geological Survey, p.163-171.
- Ontario Geological Survey 1980. Airborne electromagnetic and total intensity magnetic survey, Atikokan-Mine Centre area, western part, District of Rainy River; Ontario Geological Survey, Maps 80 495 to 80 505, scale 1:20000.
- Parsons, A.L. 1918. Mineral developments in northwestern Ontario; Ontario Bureau of Mines, Annual Report, 1918, v.27, pt.1, p.168-186.
- Peterman, Z.E. 1959. Petrology of the metasediments of the Rainy Lake region; unpublished MSc thesis, University of Minnesota, Minneapolis, Minnesota, 62p.
- Peterman, Z.E., Goldich, S.S., Hedge, C.E. and Yardley, D.H. 1972. Geochronology of the Rainy Lake region, Minnesota-Ontario; in *Studies in Mineralogy and Precambrian Geology*, Geological Society of America, Memoir 135, p.193-215.
- Pirie, J. and Mackasey, W.O. 1978. Preliminary examination of regional metamorphism in parts of Quetico metasedimentary belt, Superior Province, Ontario; in *Metamorphism in the Canadian Shield*, Geological Survey of Canada, Paper 78-10, p.37-48.

- Pluysina, L.P. and Ivanov, I.P. 1981. Thermodynamic regime of greenstone metamorphism of basic volcanic rocks after experimental data; *Canadian Journal of Earth Sciences*, v.18, p.1303-1309.
- Poulsen, K.H. 1980a. The stratigraphy, structure and metamorphism of Archean rocks at Rainy Lake, Ontario; unpublished MSc thesis, Lakehead University, Thunder Bay, Ontario, 99p.
- 1980b. The geological setting of mineralization in the Mine Centre-Fort Frances area, District of Rainy River; in *Summary of Field Work*, 1980, Ontario Geological Survey, Miscellaneous Paper 96, p.162-168.
- 1981. The geological setting of mineralization in the Mine Centre-Fort Frances area, District of Rainy River; in *Summary of Field Work*, 1981, Ontario Geological Survey, Miscellaneous Paper 100, p.190-195.
- Poulsen, K.H., Borradaile, G.J. and Kehlenbeck, M.M. 1980. An inverted Archean succession at Rainy Lake, Ontario; *Canadian Journal of Earth Sciences*, v.17, p.1358-1369.
- Robertson, J.A. 1968. Uranium and thorium deposits of northern Ontario; Ontario Department of Mines, Mineral Resources Circular 9, 106p.
- Robinson, A.H.A. 1920. Investigation of pyrites resources; in *Canadian Mines Branch, Summary Report; Sessional Paper Number 26a*, 1919, (Report Number 509), p.13-46.
- 1922. Titanium; Canada Department of Mines, Mines Branch, Report Number 579, 127p.
- Rogers, W.R. 1920. Statistical review of the mining industry of Ontario for 1919; Ontario Department of Mines, Annual Report, 1920, v.29, pt.1, p.1-60.
- 1922. Statistical review of Ontario's mineral industry in 1920; Ontario Department of Mines, Annual Report, 1921, v.30, pt.1, p.1-54.
- Rogers, W.R. and Young A.C. 1935. Statistical review of Ontario's mineral industry in 1933; Ontario Department of Mines, Annual Report, 1934, v.43, pt.1, p.1-46.
- Rose, E.R. 1969. Geology of titanium and titaniferous deposits of Canada; Geological Survey of Canada, Economic Geology Report 25, 177p.
- Sangster, D.F. 1972. Precambrian volcanogenic massive sulphide deposits in Canada: a review; Geological Survey of Canada, Paper 72-22, 44p.
- Schwerdtner, W.M., Stone, D., Osadetz, K., Morgan, J. and Stott, G.M. 1979. Granitoid complexes and the Archean tectonic record in the southern part of northwestern Ontario; *Canadian Journal of Earth Sciences*, v.16, p.1965-1977.
- Shklanka, R. 1968. Iron deposits of Ontario; Ontario Department of Mines, Mineral Resources Circular 11, 489p.
- 1969. Copper, nickel, lead and zinc deposits of Ontario; Ontario Department of Mines, Mineral Resources Circular 12, 394p.
- Sinclair, D.G. 1935. Mines of Ontario in 1933; Ontario Department of Mines, Annual Report, 1934, v.43, pt.1, p.59-120.
- 1936. Mines of Ontario in 1934; Ontario Department of Mines, Annual Report, 1935, v.44, pt.1, p.67-167.
- 1937. Mines of Ontario in 1935; Ontario Department of Mines, Annual Report, 1936, v.45, pt.1, p.77-188.
- 1938. Mines of Ontario in 1936; Ontario Department of Mines, Annual Report, 1937, v.46, pt.1, p.90-238.
- 1939. Mines of Ontario in 1937; Ontario Department of Mines, Annual Report, 1938, v.47, pt.1, p.80-249.
- 1940. Mines of Ontario in 1938; Ontario Department of Mines, Annual Report, 1939, v.48, pt.1, p.72-239.
- Slaght, A. 1897. Seventh report of the Inspector of Mines; Ontario Bureau of Mines, Annual Report, 1896, v.6, p.245-281.
- Southwick, D.L. 1972. Vermilion granite-migmatite massif; in *Geology of Minnesota: A Centennial Volume*, Minnesota Geological Survey, p.108-119.
- 1976. High-grade metamorphism associated with the Vermilion Batholith, Minnesota-Ontario; abstract in *Program with Abstracts*, Institute on Lake Superior Geology, 22nd Annual Meeting, St. Paul, Minnesota, p.61.
- Southwick, D.L. and Sims, P.K. 1980. The Vermilion Granitic Complex—a new name for old rocks in northern Minnesota; in *Shorter Contributions to Mineralogy and Petrology*, 1979, United States Geological Survey, Professional Paper 1124 A-F, p.A1-A11.
- Streckeisen, A. 1976. To each plutonic rock its proper name; *Earth Science Reviews*, v.12, p.1-33.
- Sutherland, T.F. 1920. Mines of Ontario in 1919; Ontario Department of Mines, Annual Report, 1920, v.29, pt.1, p.66-141.
- 1926. Mines of Ontario in 1924; Ontario Department of Mines, Annual Report, 1925, v.34, pt.1, p.66-169.
- 1929. Mines of Ontario in 1927; Ontario Department of Mines, Annual Report, 1928, v.37, pt.1, p.73-184.
- Tanton, T.L. 1935. Preliminary report on Mine Centre area, Ontario; unpublished report, Bureau of Economic Geology, Department of Mines, Ottawa.
- 1936. Mine Centre area, Rainy River District, Ontario; Geological Survey of Canada, Coloured Map 334A, scale 1:31680.
- Tower, W.O. 1942. Mines of Ontario in 1940; Ontario Department of Mines, Annual Report, 1941, v.50, pt.1, p.1-166.
- 1946. Mines of Ontario in 1942; Ontario Department of Mines, Annual Report, 1943, v.52, pt.1, p.68-230.
- Tremblay, M. 1941. Statistical review of the mineral industry of Ontario for 1939; Ontario Department of Mines, Annual Report, 1940, v.49, pt.1, p.1-54.
- Wood, J. 1980. Epiclastic sedimentation and stratigraphy in the North Spirit Lake and Rainy Lake areas: a comparison; *Precambrian Research*, v.12, p.227-255.
- Wood, J., Dekker, J., Jansen, J.G., Keay, J.P. and Panagapko, D. 1980a. Mine Centre area (western half), District of Rainy River; Ontario Geological Survey, Preliminary Map P.2201, scale 1:15 840.
- 1980b. Mine Centre area (eastern half), District of Rainy River; Ontario Geological Survey, Preliminary Map P.2202, scale 1:15 840.

Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	Multiplied by	Gives	Imperial Unit	Multiplied by	Gives
LENGTH					
1 mm	0.039 37	inches	1 inch	25.4	mm
1 cm	0.393 70	inches	1 inch	2.54	cm
1 m	3.280 84	feet	1 foot	0.304 8	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	1.609 344	km
AREA					
1 cm ²	0.155 0	square inches	1 square inch	6.451 6	cm ²
1 m ²	10.763 9	square feet	1 square foot	0.092 903 04	m ²
1 km ²	0.386 10	square miles	1 square mile	2.589 988	km ²
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
VOLUME					
1 cm ³	0.061 023	cubic inches	1 cubic inch	16.387 064	cm ³
1 m ³	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m ³
1 m ³	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m ³
CAPACITY					
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	4.546 090	L
MASS					
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	31.103 476 8	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	0.453 592 37	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	907.184 74	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	0.907 184 74	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	1016.046 908 8	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	1.016 046 90	t
CONCENTRATION					
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

MAPS NOT FILMED

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